MOHAVE DESERT, CALIFORNIA, SHOWING TREE YUCCAS.

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THE DEATH VALLEY EXPEDITION

A BIOLOGICAL SURVEY OF PARTS OF CALIFORNIA, NEVADA, ARIZONA, AND UTAH

PART II

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., December 28, 1892.

SIR: I have the honor to transmit herewith the manuscript of North American Fauna, No. 7, consisting of Part II of the report on the results of the Death Valley Expedition, a biological survey of southern California, southern Nevada, and parts of Utah and Arizona, carried on by your authority in 1891. It consists of the special reports on birds, reptiles, batrachians, fishes, molluscs, insects, and the desert shrubs, cactuses, and yuccas, and is accompanied by a list of localities.

Part I, comprising the general report (itinerary, description of the region, and discussion of life zones) and the report on mammals, is not yet ready for the press.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

Hon. J. M. RUSK,
Secretary of Agriculture.

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REPORT ON THE ORNITHOLOGY OF THE DEATH VALLEY EXPEDITION OF 1891, COMPRISING NOTES ON THE BIRDS OBSERVED IN SOUTHERN CALIFORNIA, SOUTHERN NEVADA, AND PARTS OF ARIZONA AND UTAH.

By A. K. Fisher, M. D.

The present report includes an enumeration of all the birds observed throughout the region traversed by the different members of the expedition. It was considered advisable to unite all the observations in one general report rather than attempt to treat of the avifauna of special localities in a number of separate papers. At the same time a few local lists may be found under particular areas in Part I.

A number of side trips were made to special localities by small parties, which not only materially increased the observations on the birds already met with, but also added a number of species to the list. Among these trips may be mentioned one made by Dr. Merriam and Mr. Bailey, who extended their observations as far east as St. George, Utah. They were thereby enabled to add valuable notes on several of the birds of the Great Basin not seen elsewhere. After the main party had disbanded in the fall, a trip was made by Mr. Nelson along the coast from San Simeon to Carpenteria, and one to Monterey by Mr. Bailey, which resulted in partially filling up a wide gap among the water birds.

Owing to the unusual interest shown in matters relating to Death Valley, and to the entire absence of reliable information concerning the species inhabiting this area, it seemed best to append a special list of the birds observed there, with brief annotations. This list is believed to be reasonably complete, since the valley was visited by one or more members of the expedition every month except May, from January to June inclusive. A list of the species found in Owens Valley is added for comparison. (See pp. 150–158.)

The known ranges of a number of species were much extended by the expedition, notably in the cases of *Oreortyx pictus plumiferus*, *Dryobates scalaris bairdi*, *Chordeiles texensis*, *Pyrocephalus rubineus mexicanus*, *Calypte costæ*, *Icterus parisorum*, *Leucosticte tephrocotis*, *Junco hyemalis thurberi*, *Spizella atrigularis*, *Peucæa cassini*, *Harporhynchus lecontei*, and a few others; and the distribution of many better-known species was more definitely determined.

The known range of the plumed quail (*Oreortyx pictus plumiferus*) was carried eastward from the eastern slope of the Sierra Nevada to Mount Magruder, Nevada, and to all the desert ranges of southern California west of Death Valley. This valley apparently limits the distribution of this bird on the east, as the species was nowhere seen in the Grapevine or Charleston mountains, although both ranges are well timbered and bear brush which might afford suitable food and shelter.

Baird's woodpecker (*Dryobates scalaris bairdi*) was quite common among the tree yuccas on the Mohave Desert at Hesperia, and its range was extended northward to Vegas Valley, Nevada, and the valley of the Santa Clara, in southwestern Utah, by Dr. Merriam. The vermilion flycatcher also was secured in the same valley, though previously unknown north of Fort Mohave, Ariz. The Texas nighthawk (*Chordeiles texensis*) was found to be a common summer resident in all the valleys east of the Sierra Nevada from Owens Valley, California, to St. George, Utah, where Dr. Merriam secured the eggs. It was taken also in the San Joaquin Valley, California, near Bakersfield. Scott's oriole (*Icterus parisorum*) is another species whose range was carried northward from a short distance above our southern border in California to about latitude 38°, where it was common in places among the tree yuccas, and also on the slopes of some of the desert ranges as high as the junipers and piñons. Along the northern line of distribution it was found in Nevada at the Queen mine in the White Mountains, at Mount Magruder, and in the Juniper Mountains, and in Utah in the Beaverdam Mountains. Costa's humming bird (*Calypte costæ*) was very common wherever water occurred throughout the desert region, ranging northward nearly to latitude 38°, and eastward to the Beaverdam Mountains, Utah. Its nest was frequently found in the low bushes and cactuses on the hillsides near springs and streams.

The discovery that the gray-crowned finch (*Leucosticte tephrocotis*) breeds in the southern Sierra and in the White Mountains is especially interesting both because its breeding range was previously unknown, and because no species of the genus had been recorded from the Sierra Nevada south of about latitude 40°, while the present species was common nearly to the 36th parallel.

Most satisfactory results were accomplished in working out the distribution of Thurber's junco (*Junco hyemalis thurberi*), a recently described race whose range was not definitely known. In the Sierra Nevada it was common from the Yosemite Valley, the most northern point visited by any member of the expedition, to the southern end of the range, and in the desert ranges eastward to the Grapevine and Charleston mountains, where its place was occupied, in winter at least, by its more eastern representative, Shufeldt's junco. The little black-chinned sparrow (*Spizella atrigularis*) was found to be not an uncommon summer resident on the slopes of several of the desert ranges and also on the east slope of the Sierra Nevada as far north as Independence Creek in Kearsarge Pass. This was a great surprise, as heretofore the species has been recorded within our limits only along the southern border, and its presence was not suspected until a specimen was taken in the Panamint Mountains in April.

LeConte's thrasher (*Harporhynchus lecontei*), contrary to our expectations, was a common resident throughout the principal desert valleys from Owens Valley at the east foot of the Sierra Nevada across southern California and Nevada to southwestern Utah, where it was found nearly to the summit of the Beaverdam Mountains. Northward it was observed in Owens Valley almost to Benton, a short distance south of the 38th parallel. It was also taken by Mr. Nelson in the southern part of the San Joaquin Valley, California, about Buena Vista Lake.

The bird life of a region is materially affected by various agencies, such as changes in the character of the country brought about by the destruction of forests, the drying up of springs and water courses, and other causes. But in the High Sierra the sheep industry is doing more than anything else to make that region uninhabitable for certain species of birds and also for other forms of life, as long since pointed out by Mr. Henshaw (Appendix JJ, Annual Report of the Chief of Engineers for 1876, p. 225). During the summer the sheep almost totally destroy all the smaller plants and shrubs which, except in the wet meadows, do not grow again until the following spring. The writer has walked for miles along the hillsides where these animals had recently grazed without seeing a plant of any description save the larger woody shrubs. That the destruction of vegetation by sheep in this region is a potent cause of the scarcity of ground-inhabiting birds is evident by contrast to anyone visiting the national parks where no sheep are allowed to graze and where the vegetation is consequently uninjured and many species of birds abundant.

One member of the expedition, Mr. Vernon Bailey, traversed the Virgin Valley in southwestern Utah and eastern Nevada and the Detrital and Sacramento valleys, Arizona, during the winter of 1888–'89. His notes on several of the birds observed are incorporated in the present report.

With few exceptions it was thought better not to include matter from published reports partially covering the same region, since most of this material has been republished already in Mr. Belding's Land Birds of the Pacific Coast District.

In the following report 290 species and subspecies of birds are dwelt upon at greater or less length. The nomenclature adopted is that of the American Ornithologists' Union.

The writer wishes to extend his sincere thanks to all members of the expedition who assisted in collecting specimens or information for the present report. He wishes also to acknowledge the kindness of Mr. L. Belding, who furnished data on certain birds observed by him during a short trip to the Yosemite National Park in June, 1891. In all important instances credit is given to the observer under the head of each species.

Without this substantial help, so freely given, little more than a fragmentary report would have been possible.

LIST OF BIRDS.

1. *Æchmophorus occidentalis.*
2. *Colymbus nigricollis californicus.*
3. *Podilymbus podiceps.*
4. *Urinator imber.*
5. *Urinator pacificus.*
6. *Urinator lumme.*
7. *Uria troile californica.*
8. *Larus glaucescens.*
9. *Larus californicus.*
10. *Larus delawarensis.*
11. *Larus heermanni.*
12. *Larus philadelphia.*
13. *Sterna maxima.*
14. *Phalacrocorax dilophus albociliatus.*
15. *Phalacrocorax penicillatus.*
16. *Phalacrocorax pelagicus resplendens.*
17. *Pelecanus erythrorhynchos.*
18. *Pelecanus californicus.*
19. *Merganser americanus.*
20. *Merganser serrator.*
21. *Anas boschas.*
22. *Anas strepera.*
23. *Anas americana.*
24. *Anas carolinensis.*
25. *Anas discors.*
26. *Anas cyanoptera.*
27. *Spatula clypeata.*
28. *Dafila acuta.*
29. *Aythya americana.*
30. *Aythya vallisneria.*
31. *Aythya collaris.*
32. *Glaucionetta clangula americana.*
33. *Charitonetta albeola.*
34. *Histrionicus histrionicus.*
35. *Oidemia americana.*
36. *Oidemia perspicillata.*
37. *Erismatura rubida.*
38. *Chen hyperborea.*
39. *Anser albifrons gambeli.*
40. *Branta canadensis hutchinsii.*
41. *Branta canadensis occidentalis.*
42. *Dendrocygna fulva.*
43. *Plegadis guarauna.*
44. *Botaurus lentiginosus.*
45. *Ardea herodias.*
46. *Ardea egretta.*
47. *Ardea virescens.*
48. *Nycticorax nycticorax nævius.*
49. *Grus canadensis.*
50. *Rallus virginianus.*
51. *Porzana carolina.*
52. *Fulica americana.*
53. *Phalaropus tricolor.*
54. *Recurvirostra americana.*
55. *Himantopus mexicanus.*
56. *Gallinago delicata.*
57. *Tringa minutilla.*
58. *Ereunetes occidentalis.*
59. *Calidris arenaria.*
60. *Limosa fedoa.*
61. *Totanus melanoleucus.*
62. *Symphemia semipalmata inornata.*
63. *Heteractitis incanus.*
64. *Actitis macularia.*
65. *Numenius longirostris.*
66. *Numenius hudsonicus.*
67. *Charadrius squatarola.*
68. *Ægialitis vocifera.*
69. *Ægialitis nivosa.*
70. *Ægialitis montana.*
71. *Oreortyx pictus plumiferus.*
72. *Callipepla californica.*
73. *Callipepla californica vallicola.*
74. *Callipepla gambeli.*
75. *Dendragapus obscurus fuliginosus.*
76. *Centrocercus urophasianus.*
77. *Columba fasciata.*
78. *Zenaidura macroura.*
79. *Pseudogryphus californianus.*
80. *Cathartes aura.*
81. *Elanus leucurus.*
82. *Circus hudsonius.*
83. *Accipiter velox.*
84. *Accipiter cooperi.*
85. *Accipiter atricapillus striatulus.*
86. *Buteo borealis calurus.*
87. *Buteo lineatus elegans.*
88. *Buteo swainsoni.*
89. *Archibuteo ferrugineus.*
90. *Aquila chrysaëtos.*
91. *Haliæetus leucocephalus.*
92. *Falco mexicanus.*
93. *Falco peregrinus anatum.*
94. *Falco columbarius.*
95. *Falco sparverius deserticolus.*
96. *Pandion haliaëtus carolinensis.*
97. *Strix pratincola.*
98. *Asio wilsonianus.*
99. *Asio accipitrinus.*
100. *Syrnium occidentale.*

LIST OF BIRDS—Continued.

101. *Megascops asio bendirei.*
102. *Bubo virginianus subarcticus.*
103. *Speotyto cunicularia hypogæa.*
104. *Geococcyx californianus.*
105. *Coccyzus americanus occidentalis.*
106. *Ceryle alcyon.*
107. *Dryobates villosus hyloscopus.*
108. *Dryobates pubescens gairdnerii.*
109. *Dryobates scalaris bairdi.*
110. *Dryobates nuttallii.*
111. *Xenopicus albolarvatus.*
112. *Sphyrapicus varius nuchalis.*
113. *Sphyrapicus ruber.*
114. *Sphyrapicus thyroideus.*
115. *Ceophlœus pileatus.*
116. *Melanerpes formicivorous bairdi.*
117. *Melanerpes torquatus.*
118. *Melanerpes uropygialis.*
119. *Colaptes cafer.*
120. *Phalænoptilus nuttalli.*
121. *Phalænoptilus nuttalli californicus.*
122. *Chordeiles virginianus henryi.*
123. *Chordeiles texensis.*
124. *Cypseloides niger.*
125. *Chætura vauxi.*
126. *Aëronautes melanoleucus.*
127. *Trochilus alexandri.*
128. *Calypte costæ.*
129. *Calypte anna.*
130. *Selasphorus platycercus.*
131. *Selasphorus rufus.*
132. *Stellula calliope.*
133. *Tyrannus tyrannus.*
134. *Tyrannus verticalis.*
135. *Tyrannus vociferans.*
136. *Myiarchus cinerascens.*
137. *Sayornis saya.*
138. *Sayornis nigricans.*
139. *Contopus borealis.*
140. *Contopus richardsonii.*
141. *Empidonax difficilis.*
142. *Empidonax pusillus.*
143. *Empidonax hammondi.*
144. *Empidonax wrightii.*
145. *Pyrocephalus rubineus mexicanus.*
146. *Otocoris alpestris arenicola.*
147. *Otocoris alpestris chrysolæma.*
148. *Pica pica hudsonica.*
149. *Pica nuttalli.*
150. *Cyanocitta stelleri.*
151. *Cyanocitta stelleri frontalis.*
152. *Aphelocoma woodhousei.*
153. *Aphelocoma californica.*
154. *Corvus corax sinuatus.*
155. *Corvus americanus.*
156. *Picicorvus columbianus.*
157. *Cyanocephalus cyanocephalus.*
158. *Molothrus ater.*
159. *Xanthocephalus xanthocephalus.*
160. *Agelaius phœniceus.*
161. *Agelaius gubernator.*
162. *Sturnella magna neglecta.*
163. *Icterus parisorum.*
164. *Icterus bullocki.*
165. *Scolecophagus cyanocephalus.*
166. *Coccothraustes vespertinus.*
167. *Pinicola enucleator.*
168. *Carpodacus purpureus californicus.*
169. *Carpodacus cassini.*
170. *Carpodacus mexicanus frontalis.*
171. *Loxia curvirostra stricklandi.*
172. *Leucosticte tephrocotis.*
173. *Leucosticte atrata.*
174. *Spinus tristis.*
175. *Spinus psaltria.*
176. *Spinus psaltria arizonæ.*
177. *Spinus lawrencei.*
178. *Spinus pinus.*
179. *Poocætes gramineus confinis.*
180. *Ammodramus sandwichensis alaudinus.*
181. *Ammodramus sandwichensis bryanti.*
182. *Chondestes grammacus strigatus.*
183. *Zonotrichia leucophrys.*
184. *Zonotrichia leucophrys intermedia.*
185. *Zonotrichia leucophrys gambeli.*
186. *Zonotrichia coronata.*
187. *Zonotrichia albicollis.*
188. *Spizella monticola ochracea.*
189. *Spizella socialis arizonæ.*
190. *Spizella breweri.*
191. *Spizella atrigularis.*
192. *Junco hyemalis.*
193. *Junco hyemalis shufeldti.*
194. *Junco hyemalis thurberi.*
195. *Junco pinosus.*
196. *Amphispiza bilineata.*
197. *Amphispiza belli.*
198. *Amphispiza belli nevadensis.*
199. *Peucæa cassini.*
200. *Peucæa ruficeps.*
201. *Melospiza fasciata fallax.*
202. *Melospiza fasciata montana.*
203. *Melospiza fasciata heermanni.*
204. *Melospiza fasciata guttata.*
205. *Melospiza fasciata rufina.*
206. *Melospiza fasciata graminea.*
207. *Melospiza lincolni.*
208. *Passerella iliaca unalaschcensis.*

LIST OF BIRDS—Continued.

209. *Passerella iliaca megarhyncha.*
210. *Passerella iliaca schistacea.*
211. *Pipilo maculatus megalonyx.*
212. *Pipilo maculatus oregonus.*
213. *Pipilo chlorurus.*
214. *Pipilo fuscus mesoleucus.*
215. *Pipilo fuscus crissalis.*
216. *Pipilo aberti.*
217. *Habia melanocephala.*
218. *Guiraca cærulea eurhyncha.*
219. *Passerina amœna.*
220. *Calamospiza melanocorys.*
221. *Piranga ludoviciana.*
222. *Piranga hepatica.*
223. *Progne subis hesperia.*
224. *Petrochelidon lunifrons.*
225. *Chelidon erythrogaster.*
226. *Tachycineta bicolor.*
227. *Tachycineta thalassina.*
228. *Clivicola riparia.*
229. *Stelgidopteryx serripennis.*
230. *Ampelis cedrorum.*
231. *Phainopepla nitens.*
232. *Lanius ludovicianus excubitorides.*
233. *Vireo gilvus swainsoni.*
234. *Vireo solitarius cassinii.*
235. *Vireo solitarius plumbeus.*
236. *Vireo bellii pusillus.*
237. *Vireo vicinior.*
238. *Helminthophila luciæ.*
239. *Helminthophila ruficapilla gutturalis.*
240. *Helminthophila celata lutescens.*
241. *Dendroica æstiva.*
242. *Dendroica auduboni.*
243. *Dendroica nigrescens.*
244. *Dendroica townsendi.*
245. *Dendroica occidentalis.*
246. *Seiurus noveboracensis notabilis.*
247. *Geothlypis macgillivrayi.*
248. *Geothlypis trichas occidentalis.*
249. *Icteria virens longicauda.*
250. *Sylvania pusilla pileolata.*
251. *Anthus pensylvanicus.*
252. *Cinclus mexicanus.*
253. *Oroscoptes montanus.*
254. *Mimus polyglottos.*
255. *Harporhynchus redivivus.*
256. *Harporhynchus lecontei.*
257. *Harporhynchus crissalis.*
258. *Heleodytes brunneicapillus.*
259. *Salpinctes obsoletus.*
260. *Catherpes mexicanus conspersus.*
261. *Thryothorus bewickii spilurus.*
262. *Thryothorus bewickii bairdi.*
263. *Troglodytes aëdon aztecus.*
264. *Cistothorus palustris paludicola.*
265. *Certhia familiaris occidentalis.*
266. *Sitta carolinensis aculeata.*
267. *Sitta canadensis.*
268. *Sitta pygmæa.*
269. *Parus inornatus.*
270. *Parus inornatus griseus.*
271. *Parus gambeli.*
272. *Parus rufescens neglectus.*
273. *Chamæa fasciata henshawi.*
274. *Psaltriparus minimus californicus.*
275. *Psaltriparus plumbeus.*
276. *Auriparus flaviceps.*
277. *Regulus satrapa olivaceus.*
278. *Regulus calendula.*
279. *Polioptila cærulea obscura.*
280. *Polioptila plumbea.*
281. *Polioptila californica.*
282. *Myadestes townsendii.*
283. *Turdus ustulatus.*
284. *Turdus ustulatus swainsonii.*
285. *Turdus aonalaschkæ.*
286. *Turdus aonalaschkæ auduboni.*
287. *Merula migratoria propinqua.*
288. *Hesperocichla nævia.*
289. *Sialia mexicana.*
290. *Sialia arctica.*

Æchmophorus occidentalis. Western Grebe.

The western grebe was seen only in the San Joaquin Valley, where Mr. Nelson observed a few at Buena Vista Lake, in October.

Colymbus nigricollis californicus. Eared Grebe.

The eared grebe was found in most of the larger ponds or lakes throughout the region visited by the expedition. At Owens Lake, Calif., large flocks were seen as late as the middle of June. Hundreds of dead ones were observed along the shore, where they were drifted by the wind. The writer counted the bodies found within the limits of a given distance, and estimated the total for the entire lake shore as 35,000. One of two causes, or both combined, must account for the death of so many. Either the water, which is saturated with salt and soda, is in some way injurious to them, or remaining to search for proper food, which does not exist in the lake, they become so weak from innutrition as to be unable to fly and die of starvation.

The mortality observed is not unusual, but seems to be of regular occurrence. Mr. Nelson, while camped at Keeler, in December, 1890, reported large numbers of dead grebes along the shore, and further stated that a light wind, blowing in shore, brought in half a dozen or more recently dead and excessively emaciated birds.

A specimen was secured on the reservoir at Furnace Creek, Death Valley, by Mr. Bailey April 11, and another on Pahranagat Lake, where many others were seen, May 24. Mr. Nelson saw a single individual in a glacier lake at the head of San Joaquin River, which was more likely the horned grebe; Mr. Stephens found several at Little Owens Lake, May 6–11; and Mr. Palmer observed eight or ten pairs, in full breeding plumage, on Elizabeth Lake July 2, and several on Crane Lake, near Gorman Station, Calif., June 28. Mr. Nelson saw the species at Buena Vista Lake, in the San Joaquin Valley, in October, and found it common along the coast south of San Simeon in November.

The horned grebe (*Colymbus auritus*) may have been associated with the present species in some localities, but it was not identified.

Record of specimens collected of Colymbus nigricollis californicus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
....	♂	Death Valley, California	Apr. 11, 1891	V. Bailey	Furnace Creek.
....	♂	Keeler, Inyo Co., Calif.........	June 2, 1891	T. S. Palmer......	

Podilymbus podiceps. Pied-billed Grebe.

A few dabchicks were seen by Mr. Nelson along the coast between San Simeon and Carpenteria, in November.

Urinator sp.——?

Mr. Nelson reported loons as common along the coast south of San Simeon in November. No adults were observed, all the birds being in immature plumage and remarkably unsuspicious. It is probable that the above note includes two and possibly three species, namely, the Pacific, red-throated, and common loons.

Uria troile californica. California Murre.

The California murre was found by Mr. Bailey to be common along the shore at Monterey, Calif., where a female was secured October 5.

Larus glaucescens. Glaucous-winged Gull.

Mr. Nelson found this species common along the coast of California south of San Simeon in November.

Larus californicus. California Gull.

Mr. Nelson saw three gulls of this species flying up Owens River, California, opposite Lone Pine, in December, 1890. Along the shores of Owens Lake from one to half a dozen were seen almost every day through December. A specimen shot on December 28 had its craw full of duck meat and feathers, and from the actions of its associates when a duck was shot it was evident that they prey upon such game, since the lake affords little other food.

The same observer saw a number of gulls of this species at Buena Vista Lake, in the San Joaquin Valley, in October, and found it common along the coast from San Simeon to Carpenteria, November 4 to December 18, 1891.

Larus delawarensis. Ring-billed Gull.

Mr. Nelson observed the ring-billed gull a few times at Owens Lake, and secured two specimens at a pond abounding in small fish near Lone Pine, in December, 1890. He found it rather common along the coast from San Simeon to Carpenteria, November 4 to December 18, 1891.

Larus heermanni. Heermann's Gull.

Common along the coast from San Simeon to Carpenteria, November 4 to December 18, 1891.

Larus philadelphia. Bonaparte's Gull.

Mr. Nelson saw one immature bird on a small lake near Lone Pine the last of December, 1890, and found a few along the coast from San Simeon to Carpenteria, November 4 to December 18, 1891.

Sterna maxima. Royal Tern.

A large tern, which Mr. Nelson reported as this species, was very common about the bays and inlets along the coast south of San Simeon.

Phalacrocorax dilophus albociliatus. Farallone Cormorant.

Mr. Nelson reported this cormorant as common along the coast from San Simeon to Carpenteria, November 4 to December 18.

Phalacrocorax penicillatus. Brandt's Cormorant.

Common in the same place.

Phalacrocorax pelagicus resplendens. Baird's Cormorant.

Noted by Mr. Nelson at Santa Barbara.

Pelecanus erythrorhynchos. White Pelican.

Mr. Stephens saw a flock of white pelicans sailing high in the air, midway between Haway Meadows and Olancha, at the southern end of Owens Lake, May 15. Mr. Palmer found the wings and shoulder girdle of one of these birds at Crane Lake, near Old Fort Tejon, July 2, and saw an individual on a small lake at Lone Pine, August 23.

Mr. Nelson saw the species at Buena Vista Lake, in the San Joaquin Valley, in October, and observed a large flock on Morro Bay in November.

Pelecanus californicus. California Brown Pelican.

Brown pelicans were common about San Francisco Bay and outside of the Golden Gate during the latter part of September. Mr. Bailey found them numerous at Monterey, September 28 to October 9, and Mr.

Nelson found them abundant all along the coast from San Simeon to Carpenteria, November 4 to December 18.

Merganser americanus. Merganser.

A flock of a dozen or more sheldrakes was seen at Soda Springs (locally known as Kern River Lakes), in the Sierra Nevada the first week in September, and a specimen shot there by Mr. Bailey August 15, belongs to this species.

Merganser serrator. Red-breasted Merganser.

A few red-breasted mergansers, according to Mr. Nelson, were living in the lakes near Lone Pine in December, 1890, and the remains of one were found on the shore of Owens Lake in June. Dr. Merriam shot an adult male in a small pond in Vegas Wash, Nevada, May 2, saw a pair at the Bend of the Colorado, May 3, and noted three females at the mouth of Beaverdam Creek, Arizona, May 9 and 10.

Anas boschas. Mallard.

The first mallard seen was a fine adult male, which was secured as it arose from one of the irrigating ditches in the alfalfa field at Furnace Creek, in Death Valley, January 23. Mr. Nelson noted several small flocks at Saratoga Springs, at the south end of the valley, early in February, and a few in Vegas Wash, Nevada, March 3–6. At Ash Meadows, Nevada, this duck was not uncommon, and a number were secured for the mess during the first three weeks in March. Dr. Merriam saw a pair of mallards and several single birds in Pahranagat Valley, Nevada, May 22–26, and Mr. Stephens noted a few in Oasis Valley, Nevada, March 15–19. In Owens Valley, California, Mr. Nelson found it sparingly about the lakes at Lone Pine in December, 1890; Mr. Stephens saw males and females at Little Owens Lake, May 6–11, and was confident that it bred in the meadows about Olancha, at the foot of Owens Lake, May 16–23. Dr. Merriam shot two and saw others in a small tule pond in Kern Valley, California, June 22, and the writer saw several at the same place July 13. At Walker Basin, California, several females were seen with their broods of young. A specimen of the latter in the down, secured July 13, had its stomach distended with grasshoppers, which insects were abundant everywhere in the neighborhood of the sloughs.

At Bakersfield, in the San Joaquin Valley, a flock of nearly full-grown birds was flushed from one of the old water ditches on July 19. At a small pond near Trout Meadows, in the Sierra Nevada, Mr. Bailey saw a flock of ten individuals about the middle of August, and on September 7 he and the writer saw a flock containing six birds at the same place. Mr. Nelson saw the species at Buena Vista Lake in October, and along the route from San Simeon to Carpenteria, in November and December.

Anas strepera. Gadwall.

The gadwall did not begin to arrive at Ash Meadows, Nevada, until about March 8, from which time until March 21, when the party left the vicinity, it increased gradually in numbers and furnished, together with many of the other ducks, an agreeable change in the fare. Mr. Nelson found the species in small numbers in the bays and creeks between San Simeon and Carpenteria, Calif., in November and December.

Anas americana. Baldpate; Widgeon.

The spring flight of widgeons began at Ash Meadows, Nevada, about March 8, where they soon became common in the small ponds and sloughs. This was the only locality where the species was at all common.

Mr. Nelson reported two or three seen and one killed at Saratoga Springs, Death Valley, California, early in February; a single bird killed in Pahrump Valley, Nevada, the middle of the same month, and one seen in Vegas Wash, Nevada, about the middle of March. Dr. Merriam mentioned one shot at Furnace Creek in Death Valley, April 8. Mr. Nelson noted a few widgeons in the bays and creeks between San Simeon and Carpenteria, Calif., in November and December.

Anas carolinensis. Green-winged Teal.

Small flocks of green-winged teal were seen at Furnace Creek, Death Valley, January 23 to February 4. They were found either at the reservoir or in the irrigating ditches which flow through the alfalfa field. At Ash Meadows, Nevada, the species was very common, occurring in flocks which varied in size from a few individuals to several hundred birds.

Mr. Nelson found it common at Saratoga Springs, in the southern end of Death Valley, early in February, at Pahrump Ranch, Nevada, February 12–28; and saw small flocks about the large springs in Pahrump and Vegas valleys, March 3–16.

At Hot Springs, Panamint Valley, the writer saw a wing of this species April 20, and Mr. Nelson saw a specimen at the same place in January. The latter observer found it common at Buena Vista Lake in the San Joaquin Valley, California, in October, and between San Simeon and Carpenteria in November and December.

Anas discors. Blue-winged Teal.

The blue-winged teal was met with in two localities only. Mr. Stephens recorded seeing a small flock at Little Owens Lake, May 6–11; and the writer shot an individual out of a mixed flock of cinnamon and green-winged teal at Ash Meadows, Nevada, March 20.

Anas cyanoptera. Cinnamon Teal.

The cinnamon teal is a common species in suitable localities throughout the desert regions of the southern part of the Great Basin. It was first observed at Ash Meadows, Nevada, March 18, at which date a few were found in mixed flocks, and a little later considerable numbers came in, both in flocks by themselves and associated with other ducks. Mr. Nelson observed a female near Jackass Spring, in Cottonwood

Cañon, Panamint Range, June 1. Mr. Stephens saw several about the ponds at Grapevine Spring, California, April 1–4, and one was secured at Hot Spring, Panamint Valley, April 17. On the last trip to Death Valley Mr. Bailey secured a female in the reservoir at Furnace Creek, June 19. It was undoubtedly a pensioner, as its ovaries were undeveloped. During the spring and early summer Dr. Merriam found this duck breeding at numerous warm springs and alkali ponds throughout the districts visited in the Lower Sonoran zone in southern Nevada and southwestern Utah, and at Little Owens Lake, California. A female was killed in a patch of fine watercress in Upper Cottonwood Spring at the east base of the Charleston Mountains, Nevada, April 30; a flock of twenty-two was seen at Vegas Spring, Nevada, May 1, and many were noted in Vegas Wash, May 2. It was seen also in the lower Santa Clara Valley, Utah, May 11–15, and was common throughout Pahranagat Valley, Nevada, May 22–26, where it was breeding in the marshes.

Record of specimens collected of Anas cyanoptera.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
134	♂ ad	Ash Meadows, Nevada	Mar. 20, 1891	A. K. Fisher	
	♀	Death Valley, California	June 19, 1891	V. Bailey	Furnace Creek.

Spatula clypeata. Shoveller.

At Lone Pine and Owens Lake, California, Mr. Nelson reported the shoveller as a common species, and at the latter place found it feeding extensively on the larvæ and pupæ of a small fly (*Ephydra hians*) which abounds in the lake. The remains of a large number of these birds were seen about the lake in June. A flock of four was seen on the reservoir at Furnace Creek, in Death Valley, the latter part of January, and the species was common at Ash Meadows, Nevada, where a number were killed early in March. Mr. Palmer found a pair breeding in a pond near Gorman Station, the last of June.

Dafila acuta. Pintail.

The sprigtail was common at Ash Meadows, Nevada, during the first two weeks in March, and many were killed for the mess. Mr. Nelson reported a number seen and some killed at Saratoga Springs, at the south end of Death Valley, February 1, and several seen in Vegas Wash, Nevada, March 3–10.

Aythya americana. Redhead.

The redhead was common at Ash Meadows, Nevada, during the first half of March, and together with the mallard, pintail, widgeon, and gadwall furnished considerable food for the party.

Mr. Nelson saw one in Vegas Valley, Nevada, in March, and Mr. Stephens another at Little Owens Lake, California, early in May.

Aythya vallisneria. Canvasback.

Ash Meadows, Nevada, was the only place where canvasback ducks were met with; a few were killed there early in March.

Aythya collaris. Ring-necked Duck.

The ring-necked duck was found only at Ash Meadows, Nevada, in March, where several in fine adult plumage were shot.

Glaucionetta clangula americana. Golden-eye.

Mr. Nelson saw a few whistlers on the lakes at Lone Pine in December, 1890, the only individuals of this species seen.

Charitonetta albeola. Bufflehead.

Mr. Nelson reported a few buffle headed ducks about the ponds at Lone Pine, California, in December, 1890.

Histrionicus histrionicus. Harlequin Duck.

None of our party saw this species. Mr. Belding, who has been so fortunate as to see a few each year, saw a pair in May, near Crockers, which is about 20 miles northwest of the Yosemite Valley.

Oidemia americana. Scoter.

Mr. Nelson found this scoter not very common at Morro Bay, California, in November.

Oidemia perspicillata. Surf Scoter.

The surf scoter was very common at Morro Bay, California, where Mr. Nelson found mainly immature birds.

Erismatura rubida. Ruddy Duck.

The ruddy duck was first met with at Ash Meadows, Nevada, where a few were killed about the middle of March. Three were seen and secured in the reservoir at Furnace Creek, Death Valley, March 22. Mr. Stephens saw it about the ponds at the ranch at Grapevine Spring, California, April 1–4; and Dr. Merriam observed it in Pahranagat Valley, Nevada, May 22–26. Near the western border of the Mohave Desert in California Mr. Palmer found several in bright plumage on Elizabeth Lake, July 2; one on a pond near Gorman Station on the same day; and several on Castac Lake, July 10. It was probably breeding at all three of these places.

Chen hyperborea. Lesser Snow Goose.

A flock of snow geese was seen by Mr. Nelson about Morro Bay in November, 1891. Mr. Bailey found this species common in flocks in Virgin Valley, where it was first observed near Bunkerville, Nev., January 23, 1889. They frequented the shores of Virgin River, where they fed on the bleached stems and tender roots of a small club-rush. The gullets of two individuals secured contained nothing except the remains of this plant.

Anser albifrons gambeli. White-fronted Goose.

A white-fronted goose remained several days in company with four Canada geese during the latter part of March in the alfalfa field at Furnace Creek, Death Valley, California.

Branta canadensis hutchinsii. Hutchin's Goose.

Very few geese were heard or seen during the time the expedition was in the field. Mr. Nelson reported hearing a flock which passed over the camp at Lone Pine, in Owens Valley, late one evening in December, 1890, and another on the east slope of the Charleston Mountains, Nevada, March 3–16, 1891. At Furnace Creek ranch, Death Valley, four Canada geese and one white-fronted goose remained in the alfalfa field for several days during the latter part of March. The above records may apply to the white-cheeked goose (*Branta c. occidentalis*). Mr. Nelson saw a few Hutchin's geese at Buena Vista Lake, in the San Joaquin Valley, California, in October, and shot a pair near San Simeon. Others were seen at different points along the coast, although nowhere common.

Dendrocygna fulva. Fulvous Tree Duck.

Owens Valley, California, was the only locality where this species was observed. Mr. Stephens found it quite common and unsuspicious at Little Owens Lake, where he secured a pair, May 8. He also saw a flock of a dozen or more at Ash Creek, near the southern end of Owens Lake, June 1.

Record of specimens collected of Dendrocygna fulva.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
34	♀	Little Owens Lake, California.	May 8, 1891	F. Stephens	
35	♂	do	do	do	

Plegadis guarauna. White-faced Glossy Ibis.

Mr. Stephens saw a small flock of the glossy ibis at Little Owens Lake, May 6–11, and observed one at a springy place at Haway Meadows May 12–14. At Furnace Creek, Death Valley, the wings and tail of a specimen which had been killed near a ditch in the alfalfa field were seen at the ranch.

Botaurus lentiginosus. Bittern.

The bittern was not uncommon at Ash Meadows, Nevada, during the first three weeks in March, where it was seen in the marshes along the irrigating ditches or by the larger springs, in which places small fish were abundant. Dr. Merriam saw several in Pahranagat Valley, Nevada, May 22–26, where it undoubtedly bred. In Owens Valley Mr. Stephens found it at Alvord June 26–28; at Bishop, June 30, and Mr. Nelson shot one near Lone Pine in December, 1890. The latter observer saw the species at the head of Morro Bay, California, and at a small lake near San Luis Obispo in November of the following year.

Ardea herodias. Great Blue Heron.

In California, great blue herons were not uncommon at Bakersfield, in the San Joaquin Valley, where they were seen flying back and forth from the river to their resting grounds, July 17–20. At the following places single individuals were seen: At a small lake near Lone Pine, December, 1890; at Tejon ranch, near the mouth of the Pass, July 13; at Little Owens Lake, June 20; at Kernville, July 12, and at Soda Springs, September 7. Mr. Nelson found the species common in the San Joaquin Valley wherever the streams or lakes furnish it proper surroundings. He reported it common on the coast between San Simeon and Carpenteria, and saw a few near San Luis Obispo and between Carpenteria and Santa Paula in November and December.

Ardea egretta. Egret.

A white egret was seen by Dr. Merriam at a little pool of muddy water between the south end of Panamint Valley and Lone Willow Spring, California, April 24; and another at the Great Bend of the Colorado, May 4. The latter was on the Arizona or east side of the river, opposite the mouth of Vegas Wash. Mr. Nelson saw several about Morro Bay, California, in November.

Ardea virescens. Green Heron.

The green heron was not uncommon along the river, sloughs, and old ditches near Bakersfield, in the San Joaquin Valley, California, July 17–20; one was seen at Elk Bayou, near Tulare, in the same valley, July 22; and Mr. Stephens saw one at Little Owens Lake, California, May 6–11.

Nycticorax nycticorax nævius. Black-crowned Night Heron.

As a matter of course, night herons were rare in a region where streams and lakes containing fish were almost absent. Dr. Merriam saw an adult April 7, resting on a rock near the road in Windy Gap, between Panamint and Death valleys. Several were seen by him on a small alkaline pond at the west end of the Mohave Desert (Antelope Valley), June 28, and one in northwestern Arizona (where Beaverdam Creek joins the Virgin), May 9. Mr. Stephens saw several at Little Owens Lake May 6–11, and Mr. Palmer saw one at Crane Lake, at the west end of the Mohave Desert, June 28, and again July 2. Mr. Bailey shot an immature specimen near the reservoir at Furnace Creek, Death Valley, June 19. Its stomach contained two carp about 5 inches long. At Keeler, in Owens Valley, one was observed near a small fresh-water pond not far from the lake, June 26. At Walker Basin several were seen flying over toward their feeding grounds, and one was observed at the edge of a slough July 13–16.

At Bakersfield, in the San Joaquin Valley, the species was common July 17–20, and at Morro Bay, on the coast, in November.

Grus canadensis. Little Brown Crane.

A little brown crane was seen for several days around the fields and marshes at Ash Meadows, Nevada, and finally was secured March 10. It was a female, and proved to be very good eating. The stomach contained small bulbous rootlets, foliage of young plants, and a quantity of barley, which it had picked up from the place where the horses had been fed.

NOTE.—Mr. Nelson saw four birds at Lone Pine, in Owens Valley, December, 1890, which he thought were whooping cranes, and saw a flock of seventeen sand-hill cranes at the Bend of the Colorado in March. In both cases the birds were too far off for positive identification, and as the region is out of the known range of the former species, it is probable that some other large bird was mistaken for it.

Rallus virginianus. Virginia Rail.

Mr. Nelson reported the species as common at Saratoga Springs in Death Valley, where Mr. Bailey caught a specimen in a trap February 3. One was seen at Ash Meadows, Nevada, about the middle of March, and the species was not uncommon at Lone Pine in Owens Valley, where two were secured June 7–10. Mr. Nelson saw one at the head of Morro Bay, Calif., in November. Dr. Merriam frequently heard a rail among the tules and reeds in Pahranagat Valley, Nevada, May 26, but was unable to say whether it was this species or the sora.

Record of specimens collected of Rallus virginianus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Death Valley, Calif.	Feb. 3, 1891	V. Bailey	Saratoga Springs.
319	♂ juv	Owens Valley, Calif.	June 7, 1891	A. K. Fisher	Lone Pine.
326	♂ juv	do	June 10, 1891	do	Do.

Porzana carolina. Sora.

A sora rail was seen at Ash Meadows, Nevada, March 10; one at Grapevine Spring, California, the first part of April; and another at Little Owens Lake, early in May. No others were seen.

Fulica americana. Coot.

Coots were common at a number of places where tulé marshes occurred. A number were seen in the Mohave Desert, along the edge of the Mohave River at Victor, early in January. In Death Valley it was found common at Saratoga Springs about February 1, and again in the latter part of April. At Ash Meadows, Nevada, it was common during the first three weeks in March, and a few were seen in Vegas Wash, early in the month. In Owens Valley, Mr. Stephens found it common at Little Owens Lake, May 6–11, and at Ash Creek, on the southwestern side of Owens Lake, the first of June. At Lone Pine it was common on the lakes in December, 1890, and at a lake south of the same place, August 23, 1891. A pair with their young was seen in a small pond, June 5. In Nevada, Dr. Merriam observed the species in the marshes in Vegas Wash, May 2; in the valley of the Muddy, May 6; and in Pahranagat Valley, May 24. At the west end of the Mohave Desert, in California, Mr. Palmer found coots common on Elizabeth Lake, July 2, and saw several on Crane Lake and on ponds near Gorman Station, June 29. Mr. Bailey found it numerous in fresh-water ponds at Monterey.

Several were seen at Soda Springs or Kern River Lakes, in the Sierra Nevada, September 7. Mr. Nelson found it abundant in the lakes and along the streams in the San Joaquin Valley, October 5-27, and along the coast. At San Simeon, he saw a group sunning themselves on a strip of sandy beach just above the reach of the incoming rollers.

Phalaropus tricolor. Wilson's Phalarope.

Mr. Bailey shot an adult male near the overflow of a ditch in the alfalfa field at Furnace Creek ranch, Death Valley, June 19, and Mr. Stephens secured two at Alvord, in Owens Valley, June 27.

Record of specimens collected of Phalaropus tricolor.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Death Valley, Calif	June 19, 1891	V. Bailey	Furnace Creek.
122	♂	Owens Valley, Calif	June 27, 1891	F. Stephens	Alvord.
123	♂	do	do	do	Do.

Recurvirostra americana. Avocet.

Avocets were found in a few places both east and west of the Sierra Nevada. A flock of eighteen was seen at Ash Meadows, Nevada, March 15, and most of them secured. Mr. Stephens saw a small flock at Little Owens Lake, California, May 6-11, and the writer saw seven standing at the edge of a bar in Kern River, below Kernville, Calif., July 13. Mr. Nelson found it sparingly about the lakes at Lone Pine, in December, 1890; at Buena Vista Lake, in the San Joaquin Valley, in October; saw one individual at the head of Owens Valley in July; and a few at Morro Bay in November. Dr. Merriam saw a dozen or more at the northwestern end of Owens Lake, June 19.

Himantopus mexicanus. Black-necked Stilt.

Near the west end of the Mohave Desert, in California, Mr. Palmer saw sixteen black-necked stilts at Elizabeth Lake, July 2, and three at Castac Lake, July 10. No others were seen during the entire season.

Gallinago delicata. Wilson's Snipe.

Wilson's snipe were seen in a few localities, both in California and Nevada.

Mr. Nelson saw several in marshy spots near Owens River at Lone Pine, Calif., until the latter part of December, 1890, when a fall in temperature drove them away. Mr. Stephens saw one at Grapevine Spring, California, April 1; a number at Little Owens Lake, May 6-11; and one at Furnace Creek, Death Valley, April 11.

Mr. Bailey flushed one at Resting Springs, California, February 16, and Mr. Nelson saw several near Cottonwood Spring at the east foot of the Charleston Mountains early in March. At Ash Meadows, Nevada, a number were seen and one killed March 16. Mr. Nelson saw one at the head of the Cañada de las Uvas and another at Buena Vista Lake, California, in October, and found the species not common, but generally distributed along the coast marshes between San Simeon and Carpenteria in November and December.

Tringa minutilla. Least Sandpiper.

Least sandpipers were seen in a few places only. Mr. Nelson reported the species as common on the shores of Owens Lake in December, 1890, and along the coast from San Simeon to Carpenteria the following autumn. Two small flocks were seen about an alkaline pond at Hot Springs in Panamint Valley, and a specimen was secured April 22. Near Bakersfield one was flushed from an old irrigating ditch July 19, and Mr. Nelson saw several near a small pond on the east side of Mount Piños, in the latter part of October.

Ereunetes occidentalis. Western Sandpiper.

The western sandpiper was seen in a few localities only. Dr. Merriam shot a specimen out of a flock of four in the Virgin Valley, Nevada, just below the mouth of the Muddy, May 6, and Mr. Stephens found the species rather common along the shore of Little Owens Lake, California, May 6–11. The writer found several in company with snowy plovers, at Keeler, on the shore of Owens Lake the 1st of June. Mr. Nelson reported it as common along the shores of Morro Bay in November.

Calidris arenaria. Sanderling.

Mr. Bailey secured a specimen of this wader at Monterey, Calif., October 3.

Limosa fedoa. Marbled Godwit.

Mr. Nelson reported this godwit as common at Morro Bay, on the coast of California, in November.

Totanus melanoleucus. Greater Yellow-legs.

Mr. Nelson reported several small parties of greater yellow-legs about the ponds at Lone Pine, Calif., in December, 1890, and found the species common at Morro Bay the following November.

Symphemia semipalmata inornata. Western Willet.

Mr. Nelson found the willet common at Morro Bay, Calif., in November.

Heteractitis incanus. Wandering Tattler.

The wandering tattler was common at Monterey, where Mr. Bailey secured a specimen October 3.

Actitis macularia. Spotted Sandpiper.

This species was not rare near the permanent streams. Dr. Merriam found it along several of the water courses in the southern part of the Great Basin, where two were found at the Great Bend of the Colorado

River in Nevada, May 4; several along Beaverdam Creek, northwestern Arizona, May 10; many in Pahranagat Valley, Nevada (where the species was breeding), May 24; and one in Oasis Valley, Nevada, June 1.

Mr. Nelson saw a single individual on Willow Creek Cañon, in the Panamint Mountains, May 22; and observed the species at the head of Owens River and on the western slope of the Sierra Nevada, but found it nowhere common. Mr. Belding saw it at Mirror Lake, in the Yosemite Valley. The writer saw it along Kern River, near Kernville, July 11–12, and at Soda Springs or Kern River Lakes September 5. Mr. Bailey found it common around the fresh-water pools at Monterey early in October.

Numenius longirostris. Long-billed Curlew.

Mr. Nelson saw four sickle-billed curlews on the shore of Owens Lake December 27, and subsequently Mr. Bailey saw a flock of about a dozen. Mr. Stephens observed one near Ash Creek, on the same lake, the last of May.

Numenius hudsonicus. Hudsonian Curlew.

In California Mr. Nelson found the hudsonian curlew at Buena Vista Lake in the San Joaquin Valley in October, and found it common at Morro Bay in November.

Charadrius squatarola. Black-bellied Plover.

The only record of the black-bellied plover was a male secured by Mr. Bailey at Monterey, Calif., October 3.

Ægialitis vocifera. Killdeer Plover.

The killdeer plover is the commonest wader in the desert regions and occurs wherever there is water enough to form marshy places in the vicinity of streams or springs. Dr. Merriam found it particularly abundant at Hot Springs, in Panamint Valley, Calif., April 20–25; at the junction of Beaverdam Creek with the Virgin River, Arizona, May 9; along the Santa Clara River near its junction with the same river, in southwestern Utah, May 11–15; at Willow Spring, in the western part of the Mohave Desert, June 26; at Owens Lake, June 19, and in Kern Valley, California, June 22. In Nevada he found it also, though in less abundance, at Vegas Spring, May 1; at the Bend of the Colorado River, May 4; at Bunkerville, in the Virgin Valley, May 8; in Pahranagat Valley and at Pahranagat Lake, May 22–26;

The writer first observed it at Furnace Creek ranch, Death Valley, in the latter part of January, where it was noisy on moonlight nights; Dr. Merriam observed it at the same place about the middle of April; and Mr. Bailey and the writer found it not uncommon on their last trip to the Valley, June 19–22. One was seen by the latter observer at Resting Springs, California, February 16, and a number at Ash Meadows, Nevada, during the first three weeks of March. Mr. Nelson saw a few solitary individuals about the ranch in Pahrump Valley, February 12–28; also at the ranch in Vegas Valley, and thence down the Vegas Wash as far as water occurred, March 3–16. In Owens Valley the same observer found it sparingly distributed along Owens River and on the shore of Owens Lake in December, 1890, and the writer found it not uncommon in the same valley, both at Keeler and Lone Pine, June 3–15. In other parts of the valley Mr. Stephens found it at Little Owens Lake, May 6–11; Haway Meadows, May 12–14; Olancha, May 16–23; Ash Creek, May 30 to June 3; Alvord, June 26–28; Bishop, June 30 to July 1; Morans, July 4–7; and at Benton, July 9–10. He also found it rather common in Oasis Valley, Nevada, March 15–19; and at Grapevine Spring, California, April 1–4. In the Sierra Nevada Mr. Nelson found the killdeer at the head of Owens River up to an altitude of 2,440 meters (8,000 feet), and on the western slope from the San Joaquin Valley up into the Yosemite as high as 1,220 meters (4,000 feet); Mr. Stephens found it common at Menache Meadows, May 24–26; and Mr. Dutcher saw one on Big Cottonwood Creek about half a mile below his meteorological camp, September 11. Near the west end of the Mohave Desert Mr. Palmer saw the species at Elizabeth Lake, July 2, and near Crane Lake, June 29. The writer saw killdeers on the eastern slope of Walker Pass, July 1, and Mr. Bailey on the western slope the following day. Several were seen at the South Fork of Kern River, July 3–10; at Kernville, July 11–13; at Walker Basin, July 13–16; and at Bakersfield, in the San Joaquin Valley, July 17–20. At Three Rivers, California, in the western foothills of the Sierra, the killdeer plover was common July 25–30, and on the return trip September 14–17.

Mr. Bailey found it common at Monterey, Calif., September 28 to October 9; and Mr. Nelson reported it as common and generally distributed in the San Joaquin Valley, about San Luis Obispo, and along the coast from San Simeon to Carpenteria and Santa Paula, in November and December.

Record of specimens collected of Ægialitis vocifera.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
222	♀	Ash Meadows, Nev	Mar. 10, 1890	A. K. Fisher	
	♂	Death Valley, Calif.	June 19, 1891	V. Bailey	Furnace Creek.

Ægialitis nivosa. Snowy Plover.

This handsome little plover was observed by the writer on the shores of Owens Lake, near Keeler, May 30 to June 4, where it was common in small flocks of five or ten on the alkaline flats which border the lake. Like most other birds in the vicinity, it fed extensively, if not exclusively, on a species of small fly (*Ephydra hians* Say), which was found in immense masses near the edge of the lake. Many of these swarms of flies were four or five layers deep and covered an area of 15 or 20 square feet. Some idea can be formed of the inexhaustible supply of food which this insect furnishes for birds when it is known that colonies of equal size occurred at close intervals in suitable localities all around the lake, which has a shore line of between 40 and 50 miles.

The species was evidently breeding at the time, but no eggs or young were found. The birds were tame and unsuspicious, and allowed a person to approach within a few yards before taking wing, and if not too closely pressed would run along ahead of the observer. As Mr. Nelson found the species at this same place December 27, 1890, it is undoubtedly a resident in Owens Valley.

Mr. Bailey found this plover numerous on the beach at Monterey, Calif., September 28 to October 9.

Record of specimens collected of Ægialitis nivosa.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
276	♂	Keeler, Inyo County, Calif	June 1, 1891	A. K. Fisher	
277	♂	do	do	do	
278	♂	do	do	do	

Ægialitis montana. Mountain Plover.

According to Mr. Nelson, mountain plovers were common in flocks in October at several places on the open grassy plains in the San Joaquin Valley, Calif.

Oreortyx pictus plumiferus. Plumed Quail.

The known range of the mountain quail was considerably extended by the fieldwork of the expedition. In Cajon Pass, in the San Bernardino Mountains, a small band was seen and an individual secured January 2. In the Panamint Mountains a feather was found in Johnson Cañon, and a pair or so of the birds seen April 6. The Indians, as well as some of the inhabitants of Panamint, knew the bird well, and stated that it was common in many parts of the mountains. Dr. Merriam and Mr. Bailey saw it among the junipers on the north slope of Telescope Peak, April 17–19, and Mr. Nelson found it a common breeding species among the piñons on Willow Creek, Mill Creek, and in Cottonwood Cañon, in the more northern part of the range. Death Valley, with the barren, treeless range immediately to the east, prevents the extension of the species in that direction as effectually as it does the valley quail. In the Argus Range the plumed quail was common. Mr. W. C. Burnett saw a pair at the summit of Shepherd Cañon, and above Maturango Spring the males were heard throughout the day uttering their not unpleasant call notes. At Searl's garden, which is near the southern end of this range, Mr. Stephens heard that they came down into the garden in summer. In the Coso Mountains the species was still more common among the piñons, where several specimens were secured during the latter half of May. In the Inyo Range it was reported as not uncommon at Cerro Gordo, and Mr. Nelson found it common among the nut pines along Waucoba Creek the last of June. On Mount Magruder, Nevada, Dr. Merriam found it common and breeding June 4–9. On this mountain the plumed quails were distributed in pairs, a pair occupying the chaparral on each hillside among the piñons.

In the Sierra Nevada Mr. Stephens heard them west of Little Owens Lake, May 6–11; at Menache Meadows at an altitude of 3,050 meters (10,000 feet), May 24–26; at Independence Creek, where young were seen near the mouth of the cañon, June 18–23; and at Bishop Creek August 4–10. Mr. Nelson found the mountain quail common at the head of Owens River and on the headwaters of the San Joaquin River on the opposite slope. On the western slope of Walker Pass we found it common among the chaparral in the cañons, where it was associated more or less with the valley quail, which was abundant there. At Walker Basin a flock was seen on the hillside above the valley on July 14. In the Sierra Liebre Dr. Merriam saw one near Alamo ranch June 30, and Mr. Palmer found it common on Frazier Mountain, where half-grown young were found July 9. In the southern Sierra Nevada it was common in the Sequoia National Park, and especially near the openings, and coveys of half-grown young were seen every day during the first week in August. It was common also at Horse Corral Meadows August 9–13. A flock was seen at Big Cottonwood Meadows August 26, and another at Round Valley, 12 miles south of Mount Whitney, August 28. At the latter place birds were running about among the bare rocks above timber line. At Soda Springs, or Kern River Lakes, small flocks were seen and several individuals taken September 3. A number were observed around Mineral King the first part of August, and again in September. In the coast ranges Mr. Nelson found the plumed quail common near La Panza the last of October, and in the mountains back of San Simeon in November.

Record of specimens collected of Oreortyx pictus plumiferus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
17	♂ ad.	Cajon Pass, Calif.	Jan. 2, 1891.	A. K. Fisher.	
	♀	Panamint Mountains, Calif.	May 13, 1891.	E. W. Nelson.	
	♂	do	do	Do.	
	♂	do	May 17, 1891.	Do.	
	♂	do	May 21, 1891.	Do.	
234	♂	Argus Range, Calif.	May 13, 1891.	A. K. Fisher.	
247	♂	Coso Mountains, Calif.	May 23, 1891.	Do.	
[illegible]	♂	do	May 27, 1891.	Do.	
[illegible]	♀	do	do	Do.	
[illegible]	♂ juv.	Walker Pass, Calif.	July 3, 1891.	Do.	
[illegible]	♂ juv.	do	do	Do.	
	♂	Soda Springs, Kern River, Calif.	Aug. 12, 1891.	V. Bailey.	

Callipepla californica. California Quail.

The only places from which the typical California quail was recorded are Monterey and Boulder Creek on the coast of California, where Mr. Bailey found it common during the first part of October.

Callipepla californica vallicola. Valley Quail.

The valley quail was found abundantly in many places, and its eastern range in southern California was carefully and definitely mapped. As might be expected, it was found at every point west of the Sierra Nevada visited by members of the expedition. To the east of this range, and the ranges forming its southern continuation, the species was common out to the edge of the Mohave Desert and Salt Wells Valley, and all through Owens Valley as far north at least as Benton, where both Mr. Nelson and Mr. Stephens found it. It was common along the western base of the White Mountains and in the Inyo, Coso, Argus, and Panamint mountains. In the latter range its eastern distribution ends—Death Valley, with the barren, treeless mountains beyond forming a complete barrier to its further extension. The valley quail was not found in the Grapevine Mountains, in Panamint or Saline valleys, or in the Mohave Desert proper, though around the edges of this desert it was seen on the south at the summit of Cajon Pass, on the north at Lone Willow and Leach Point springs, and on the west at Willow Spring and Antelope Valley. The easternmost limits of its range are the San Bernardino Mountains on the south side of the Mohave Desert, and Leach Point Spring on the north side. The latter locality is only a short distance west of the extreme south end of Death Valley. Here Dr. Merriam shot specimens April 25.

In the Panamint range it was common in Johnson and Surprise Cañons, and Mr. Nelson found it in Cottonwood, Mill Creek, and Willow Creek cañons.

In the Argus Range this quail was common in Shepherd Cañon, at Maturango Spring and at other places visited. In the Coso Mountains it was found to range from the lowest part of the valley up through the cañons to the tops of the high peaks, where it was quite closely associated with the mountain quail (*Oreortyx*) during the breeding season. In the Inyo Mountains, Mr. Nelson found it on the east slope at Hunter's arastra and Waucoba Creek, and along the west slope up to the piñons. At Lone Pine, in Owens Valley, young, just able to fly, were seen June 4–15, and at Walker Pass, flocks containing a hundred or more on July 1–2. These flocks were composed of several families, as they contained from ten to fifteen adults and young that varied in size from those just hatched up to half-grown birds. At the west slope of Walker Pass, the valley quail was again found ranging above the lower limit of the mountain quail. At Three Rivers, in the western foothills of the Sierra Nevada, these quails, both adult and young, were found in the oaks feeding on the young acorns July 25–30.

Throughout the San Joaquin Valley, Mr. Nelson found it common about ranches, along water courses or near springs. It was excessively abundant at some of the springs in the hills about the Temploa Mountains and Carrizo Plain. In the week following the expiration of the close season, two men, pot-hunting for the market, were reported to have killed 8,400 quail at a solitary spring in the Temploa Mountains. The men built a brush blind near the spring, which was the only water within a distance of 20 miles, and as evening approached the quails came to it by thousands. One of Mr. Nelson's informants who saw the birds at this place stated that the ground all about the water was covered by a compact body of quails, so that the hunters mowed them down by the score at every discharge. The species was common along the coast from San Simeon to Carpenteria and Santa Paula, in November and December.

Record of specimens collected of Callipepla californica vallicola.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
16	♂ ad.	Cajon Pass, Calif	Jan. 1, 1891	A. K. Fisher	
65	♀	Lone Willow Spring, Calif	Jan. 16, 1891	do	
	♀	do	Jan. 17, 1891	E. W. Nelson	
140	♀	Panamint Mountains, Calif	Mar. 26, 1891	A. K. Fisher	Johnson Cañon.
	♂	do	Apr. 19, 1891	E. W. Nelson	Surprise Cañon.
	♀	do	do	do	Do.
	♀ juv.	do	June 13, 1891	do	
	♂	Argus Range, Calif	Jan. 2, 1891	V. Bailey	Shepherd Cañon.
	♂	do	do	do	Do.
185	♂	do	Apr. 27, 1891	A. K. Fisher	Do.
244	♂	Coso Mountains, Calif	May 21, 1891	do	
245	♀	do	do	do	
	juv.	Inyo Mountains, Calif	July 1, 1891	E. W. Nelson	
72	♂ juv.	Owens Lake, Calif	June 3, 1891	F. Stephens	
237	♀ juv.	Walker Pass, Calif	July 1, 1891	A. K. Fisher	
254	♂ juv.	do	do	do	
258	♀ juv.	do	do	do	
276	♀ juv.	Kern River, Calif	July 5, 1891	do	South Fork.
277	♂ juv.	do	do	do	
404	♂ im.	Three Rivers, Calif	July 28, 1891	do	

Callipepla gambeli. Gambel's Quail.

Gambel's quail is essentially a desert bird, though rarely found at any great distance from water. It was first observed in winter by our party at Furnace Creek, in Death Valley, where it was reported to have been introduced by the Borax Company from Resting Springs. A few young were seen here June 19–21 by Mr. Bailey and the writer, and a female shot for a specimen had an egg in the lower part of the oviduct. At Resting Springs, California, which is in the Amargosa Valley, it was excessively abundant in February and furnished considerable food for the party. It was so common among the mesquite and other brush that steel traps set for diurnal mammals were often sprung by it, and in a few instances quail were found in traps set in pouched gopher holes. A few were seen at Ash Meadows, Nevada, in March. At the ranch in Pahrump Valley, Nevada, it was fully as abundant as at Resting Springs and was considered a great nuisance by the proprietor of the place, owing to the damage it does to the crops. Mr. Nelson, who was alone in camp for several days in this locality, gives the following notes on its habits: "I noticed that when a flock of quail came to feed on grain left by the horses, an old male usually mounted the top of a tall bush close by and remained on guard for ten or fifteen minutes, then, if everything was quiet, he would fly down among his companions. At the first alarm the flock would take to the bushes, running swiftly, or flying when hard pressed. They roosted in the dense bunches of willows and cottonwoods growing along the ditches. As a rule the birds walked under the roosting place and flew up one or two at a time into the tree or bush, though sometimes they flew into the tree from a distance. When feeding they have a series of low clucking and cooing notes which are kept up almost continually."

Dr. Merriam found Gambel's quail abundant below Mountain Spring, in the southern part of the Charleston Mountains, Nevada, April 29–30, and shot several at Upper Cottonwood Springs, at the east base of the same mountains, April 30. He contributes the following notes concerning its presence in eastern Nevada, northwestern Arizona, and southwestern Utah: In Nevada it was common at the Great Bend of the Colorado, May 4, where several sprung traps set for small mammals; in the Valley of the Virgin and Lower Muddy it was not only abundant but so unwary that it ran along in front of the horses in considerable numbers, early in May; it was tolerably common in the southern part of Pahranagat Valley, May 22–26, but shy and difficult of approach. At the mouth of Beaverdam Creek, northwestern Arizona, and thence up over the Beaverdam Mountains, Utah, it was exceedingly abundant as it was also in the Santa Clara Valley, Utah, May 11–15, and a few were found as far north as the Upper Santa Clara Crossing. The species is said to reach Shoal Creek at the south end of the Escalante Desert occasionally, but is rare there.

Record of specimens collected of Callipepla gambeli.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
72	♂	Death Valley, Calif.	Jan. 24, 1891	A. K. Fisher	Furnace Creek.
73	♂	do	do	do	Do.
74	♀	do	do	do	Do.
75	♀	do	do	do	Do.
	♂	do	June 19, 1891	V. Bailey	Do.
	♀	do	do	do	Do.
102	♂ ad.	Resting Springs, Calif.	Feb. 8, 1891	A. K. Fisher	
104	♂ ad.	do	do	do	
	♂	Pahrump Valley, Nev	Feb. 15, 1891	T. S. Palmer	
28	♂	Ash Meadows, Nev	Mar. 4, 1891	F. Stephens	

Dendragapus obscurus fuliginosus. Sooty Grouse.

The Sooty Grouse was nowhere common, and the only ones seen outside of the Sierra Nevada were one by Mr. Nelson in the upper part of the White Mountains, in July, and a pair by Mr. Stephens at the Queen mill, Nevada, in the same mountains, July 11–16.

On the eastern slope of the Sierra, one was seen by Mr. Stephens at Menache Meadows, the latter part of May; another on Independence Creek about the same time; one adult and two broods, at Bishop Creek, August 4–10; and it was found sparingly at the head of

Owens River, in the latter part of July. In the Sequoia National Park a few were seen both at the saw mill and at Halsted Meadows. At Horse Corral Meadows a flock of ten or fifteen was seen and two secured, August 11. Several were seen in Kings River Cañon about the meadows, August 13–16; at Big Cottonwood Meadows throughout the summer; and grouse were not uncommon near timber line, at Mineral King and vicinity, during August and first half of September. Mr. Nelson found a few about the summit of Mount Piños in October.

Record of specimens collected of Dendragapus obscurus fuliginosus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
146	♀ juv.	Sierra Nevada Calif	Aug. 7, 1891	F. Stephens	Bishop Creek.
147	♀ juv.	do	do	do	Do.
150	♀ im.	do	Aug. 9, 1891	do	Do.
151	♀ ad.	do	do	do	Do.
160	♂ ad.	do	Aug. 23, 1891	do	Olancha Peak.
10	♂ ad.	do	July 6, 1891	B. H. Dutcher	Big Cottonwood [Meadows.

Centrocercus urophasianus. Sage Grouse.

On Mount Magruder, on the Nevada side of the boundary line between California and Nevada, many piles of sage hens' excrement were found among sage brush on the main peak, by Dr. Merriam and Mr. Bailey. They were told by a prospector that sage hens used to be common on the mountain, but are very scarce now, having been killed off a few winters ago by unusually deep snow. At the head of Owens River, on the eastern slope of the Sierra Nevada, Mr. Nelson found this bird ranging in among the lower border of the pines (*Pinus jeffreyi*,) where he saw numerous tracks. Near Mammoth Pass also he found it common among the sage brush at about 2,450 meters (8,000 feet) altitude. The same observer stated that the sage hen was a common species in the northern half of the White Mountains up to 3,050 meters (10,000 feet) altitude, where he killed a half-grown bird from a large covey. Mr. Stephens learned from the miners at the Queen mine, Nevada, that this grouse occurred in the gulches around the mines.

Columba fasciata. Band-tailed Pigeon.

At Three Rivers, in the western foothills of the Sierra Nevada, California, Mr. Palmer saw three band-tailed pigeons among the oaks the last of July, and the species was reported to be quite common in the barley stubble of a neighboring ranch. Mr. Nelson found it common among the oaks in the Tehachapi and Temploa mountains, and saw a few about San Luis Obispo during the last of October. Along the route from San Simeon to Carpenteria it was abundant among the oaks in November. Flocks of from 10 to a 100 were feeding on the berries of *Arbutus menziesii* as well as upon acorns. He saw a few flocks between Carpenteria and Santa Paula during the last part of December.

Zenaidura macroura. Mourning Dove.

After the spring migration set in, the mourning dove was a common species all through the desert region wherever water occurred. There was no bird that indicated the close proximity of water with more certainty than the dove, and wherever it was found congregated in any numbers water was confidently looked for. The three following records are the only ones which indicate its presence in the region during the winter: Two were seen drinking from a stream at San Bernardino, Calif., December 28, 1890; one was seen near the roadside at Lone Pine in the same month, and a single individual was found at Furnace Creek in Death Valley, the latter part of January. Migrants were first observed at the last-mentioned place April 9–12, and at Hot Springs, in Panamint Valley, April 21. At Lone Willow Spring Dr. Merriam saw several April 24, and at Leach Point Spring he observed large numbers as they came to the water to drink, and fifteen were secured for food the evening of April 25. In Amargosa Cañon and at Resting Springs they were seen April 27. Mr. Nelson found it exceedingly abundant in the vicinity of springs and streams in the Panamint and Grapevine mountains, where it ranged well up among the piñons. He found them more sparingly at the head of Owens River, in the Sierra Nevada, on both slopes of the Inyo Mountains, and up to the piñons in the White Mountains. They were nesting in various situations, some on the ground sheltered by a bush, others on horizontal branches of cottonwoods, willows, or piñons, and one he found in a small cup-shaped depression on the top of a tall granite boulder 6 feet from the ground. Doves were very common in the Argus Range in Shepherd Cañon and at Maturango Spring, where they filled in very nicely the shortcomings of the mess. In the Coso Mountains the species was just as abundant and occurred up through the cañons to the summit of the range.

Dr. Merriam contributes the following records for eastern Nevada, northwest Arizona, and southwest Utah: In the Charleston Mountains, Nevada, it was seen both at Mountain Spring, and at the Upper Cottonwood Springs at the east foot of the mountains, April 30; at Vegas ranch, May 1; abundant in Vegas Wash and at the Bend of the Colorado, May 2–4; in the valley of the Muddy and Virgin it was common May 7–8; in the Juniper Mountains dozens came to Sheep Spring to drink, the evening of May 18; at Pahroc Spring it was very abundant May 20–22; in Pahranagat Valley it was common and unusually tame May 22–26; at Quartz Spring, on the western slope of the Desert Mountains, it fairly swarmed on the evening of May 22, there being no other water for many miles in any direction; in Oasis Valley it was abundant June 1, feeding on seeds of the bunch grass (*Oryzopsis cuspidata*), and was common on Mount Magruder June 4–9. At the mouth of Beaverdam Creek in northwestern Arizona doves were excessively abundant May 9–10, and were common throughout the juniper belt of the Beaverdam Mountains, Utah, May 10–11. In the Santa Clara Valley, Utah, they were likewise abundant May 11–15.

In Owens Valley, California, the species was abundant from one end to the other. At Lone Pine, during the first part of June, quantities of nests, one of which contained three young, were found in the willow and cottonwood groves. During the last trip to Death Valley, Mr. Bailey and the writer found it common in the Panamint Mountains, and saw four at Furnace Creek June 19–21.

In the Sierra Nevada doves were common in Walker Pass July 1–3; along the valley of Kern River, July 3–13; at Walker Basin, July 13–16; at Bakersfield, in the San Joaquin Valley, July 17–20; at Three Rivers in the western foothills, and along the Kaweah below the pines, the last of July. In the High Sierra Mr. Palmer saw a pair in Kings River Cañon, August 14; Mr. Dutcher shot one and saw others at Big Cottonwood Meadows early in September; and it was seen at Soda Springs and Trout Meadows about the same time. In the Cañada de las Uvas, California, it was abundant at Old Fort Tejon in June and July, and Mr. Stephens found it rather common at Reche Cañon, near San Bernardino, September 22–26. Mr. Nelson reported it as common in the San Joaquin Valley in October, and saw a few along the coast from San Simeon to Carpenteria, and at Santa Paula, in November and December.

Mourning doves furnish a large amount of food to the Indians during the spring and summer. Before migration commences the Indians build rude huts of brush, grass, and weeds, in which to secrete themselves, near the springs and streams. Loopholes are made on the sides toward the water, through which arrows are shot at the birds as they alight to drink.

Record of specimens collected of Zenaidura macroura.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
[illegible]	♀ juv.	Owens Valley, Calif	June 6, 1891.	A. K. Fisher	Lone Pine.
[illegible]	♀ juv.	do	do	do	Do.

Pseudogryphus californianus. California Vulture.

It was with considerable surprise and pleasure that we found the California vulture still tolerably common in certain localities west of the Sierra Nevada, in California. Mr. Palmer reported seeing one flying above Frazier Mountain July 9, and while on his way to Tejon ranch, July 11, saw three others soaring overhead in company with turkey buzzards, and stated that it was an easy matter to distinguish the two species.

On July 16, about 3 miles from Walker Basin, on the road leading to Bakersfield, in the San Joaquin Valley, Mr. Bailey and the writer saw one of these vultures in company with the turkey buzzards flying about the carcass of a cow. The white on the underside of its wings was plainly visible.

At San Emigdio and the adjacent foothills Mr. Nelson found it quite common in October, and was told that it became very numerous there in winter. He also found it common along the coast near San Simeon, and in the Santa Ynez Mountains. In all these places it was shy and difficult of approach. On the pass at the head of Owens River, July 24, and on the trail above Lone Pine, August 27, Mr. Nelson saw solitary birds which he thought belonged to this species.

Cathartes aura. Turkey Vulture.

The turkey buzzard was seen in various localities, both in the desert and in the mountain regions, but was nowhere common. It was first met with in Death Valley, where a few were seen during the latter part of March. Dr. Merriam saw a number sailing over the Mohave Desert March 29 and 30, and saw several congregated about a dead horse at Furnace Creek, Death Valley, April 11. He saw one in Emigrant Cañon in the Panamint Mountains about the middle of April, and another at Hot Springs, in Panamint Valley, April 20. Mr. Nelson saw a few over Mesquite Valley, and in the Grapevine Mountains in May; found it sparingly in the Inyo Mountains, from the valley to the summit, in the latter part of June, and in the White Mountains in July.

In the Argus Range the writer saw it in Shepherd Cañon and at Maturango Spring, in the latter part of April and first part of May; a few were found at Coso the latter part of May, and around Owens Lake and Lone Pine in June. The species was noted all through Owens Valley, from the southern part to the upper end, and at the base of the White Mountains. On the last trip to Death Valley some were seen at Furnace Creek, June 19–21.

In the Sierra Nevada it was seen at Kernville, along the valley of the Kern River, and in Walker Basin in July; and in the High Sierra at Horse Corral, Big Cottonwood, and Whitney meadows, in August.

It was seen at Old Fort Tejon, and in Tehachapi Valley, California, in June, by Dr. Merriam and Mr. Palmer. In the San Joaquin Valley it was seen at various places from Bakersfield to Visalia and Three Rivers. Mr. Bailey saw it at Monterey the last of September; and Mr. Stephens at Reche Cañon, near San Bernardino, about the same date. In Nevada Dr. Merriam saw it in Vegas Wash, May 3; in the Virgin Valley, May 8; Pahranagat Valley, May 22–26; Ash Meadows, May 30; and a few on Mount Magruder, June 4–8. In the Santa Clara Valley, Utah, it was rather common, May 11–15.

Mr. Nelson found it common in the San Joaquin Valley, in the Tehachapi Mountains, and along the route from San Simeon to Carpenteria about the end of the year.

Elanus leucurus. White-tailed Kite.

Mr. Nelson found the white-tailed kite rather uncommon about San Luis Obispo, where he shot a specimen and saw others in November. The species was not seen elsewhere.

Circus hudsonius. Marsh Hawk.

Wherever there was sufficient water to form considerable areas of marsh land, the marsh hawk was pretty certain to be observed. An adult male was secured at Furnace Creek in Death Valley, January 29; several were seen at Resting Springs in February; and the species was not uncommon at Ash Meadows, Nevada, in March.

In Nevada Mr. Nelson found it common in Pahrump and Vegas valleys in February and March, especially about the ranch in the former place, and Mr. Stephens reported an unusual preponderance of birds in the blue plumage in Oasis Valley about the middle of March. Dr. Merriam saw one in Oasis Valley, June 1; both blue and red birds at Ash Meadows, May 30, and in Pahranagat Valley May 22–26; he shot a male in Meadow Creek Valley May 19, and saw several in the Lower Muddy and Virgin valleys May 6–8.

In California marsh hawks were common in a number of places throughout Owens Valley in winter as well as during the breeding season, and were doubtless attracted by the vast number of meadow mice (*Arvicolæ*) which swarm through the wet meadows and marshes.

Marsh hawks were common along the South Fork of Kern River, where they were seen often through the day skimming over the alfalfa fields and marshes, and in the High Sierra a few were seen at Whitney and Big Cottonwood meadows. At the west end of the Mohave Desert Dr. Merriam saw one near Gorman ranch, June 28; Mr. Bailey found it at Monterey in September, and Mr. Nelson reported it as common in the San Joaquin Valley and around Carpenteria later in the fall.

Accipiter velox. Sharp-shinned Hawk.

We found this species nowhere as common as it is in most of the Eastern States; the total number seen by members of the party, both during migration and in the breeding season, being less than could be seen in southern New York on any day in early September.

The writer saw two at the ranch at Furnace Creek, Death Valley, in the latter part of January; Mr. Nelson observed one at Bennett Wells in the same valley about the same time; and Dr. Merriam saw two at the former place, April 11. The species was seen at Resting Springs, California, the first week in February. In Nevada it was observed at Ash Meadows early in March; Mr. Nelson saw several and killed one at the ranch in Pahrump Valley February 12–28; and saw it among the mesquite thickets on his route from Ash Meadows to the Bend of the Colorado, March 3–16. Dr. Merriam saw one at Vegas Wash May 2; one at the Bend of the Colorado River, Nevada, May 4; one at the west side of the Beaverdam Mountains, Utah, May 10.

In California he saw one in Owens Valley about the middle of June, and one in Kern Valley, June 22. At Hot Springs, in Panamint Valley, Mr. Nelson shot a specimen early in January, and Dr. Merriam saw two during his stay, April 19–24; one in Emigrant Cañon, in the

Panamint Mountains, April 14; and another on the north side of Telescope Peak, April 18; and the writer saw one in Surprise Cañon, April 20.

Mr. Nelson saw the species once or twice in the piñon belt along Waucoba Creek, in the Inyo Mountains, in the latter part of June; and a few in the foothills on the west slope of the Sierra Nevada, in August. Mr. Bailey and the writer observed two or three on the western slope of Walker Pass in the same range July 2–3; one was observed in Kings River Cañon, August 15; and another at Three Rivers in the western foothills, September 13. Mr. Koch secured a pair near their camp in Cottonwood Meadows July 30; Mr. Palmer reported seeing two at Old Fort Tejon; and Mr. Bailey found it not uncommon at Whitney Meadows and at Soda Springs, in August.

Mr. Stephens saw one at Grapevine Spring, California, the first week in April; one at Olancha, at the southern end of Owens Lake, the third week in May, and one at Bishop Creek, early in August. Mr. Bailey saw several at Monterey, during the first week of October. Mr. Nelson found it common in the San Joaquin Valley between Bakersfield and San Emigdio in October, and saw a few along the coast from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Accipiter velox.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
22	♂ ad.	Sierra Nevada, Calif	July 30, 1891	B. H. Dutcher ..	Big Cottonwood Meadows.
23	♀ ad.	......do	....do	....do	Do.

Accipiter cooperi. Cooper's Hawk.

This hawk was even more rare than the sharp-shinned, as scarcely two dozen were seen during the time the expedition was in the field. In Cajon Pass in the San Bernardino Mountains, on January 2, the writer decoyed one by imitating the squealing of a mouse; one was seen at Hesperia on the Mohave Desert, January 4; one or two at the ranch at Furnace Creek, Death Valley, the latter part of the same month, and a few were seen at Ash Meadows, Nevada, during the first half of March. Mr. Stephens saw one which had been killed at Searl's garden, on Borax Flat, April 23–26, and one at Bishop Creek, in Owens Valley, the first week in August.

In the Sierra Nevada Mr. Nelson noted the species on the divide between the Merced and San Joaquin rivers; Mr. Bailey saw one on the Kaweah River; two at Whitney Meadows; the writer saw one at the latter place September 2, and secured a specimen at Three Rivers, in the western foothills, July 28. Its stomach contained the remains of a Beechey's spermophile.

Mr. Nelson found a few among the oaks in the lower part of the Tehachapi and Temploa mountains in October, and along the route beween San Simeon and Carpenteria in November.

Accipiter atricapillus striatulus. Goshawk.

No specimens of this handsome and daring hawk were taken by any member of the expedition. Mr. Nelson stated that a hawk flew over his camp at Lone Pine, Owens Valley, in December, 1890, which he thought belonged to this species, and Mr. Bailey is quite certain he saw an individual among the sequoias on Kaweah River, and another at Soda Springs, or Kern River Lakes.

Buteo borealis calurus. Western Red-tail.

The western red-tail was observed at most localities visited by members of the expedition in California, Nevada, and Utah. It was seen on the Mohave Desert near Victor, early in January, several were observed in Death Valley between Bennett Wells and Saratoga Springs about the 1st of February, and one at the former place in Death Valley, on June 21.

At Resting Springs, California, a fine specimen was secured, and others seen early in February. In Nevada it was noted at Ash Meadows, in Pahrump Valley, in Vegas Wash, at the Bend of the Colorado, at Pahroc Spring, in Pahranagat Valley, in Oasis Valley, at Mount Magruder, and on the Charleston and Grapevine mountains. On Mount Magruder one was shot by Dr. Merriam as it swooped to pick up a wounded dove, June 7, and another at the mouth of Beaverdam Creek, Arizona, May 9. The stomach of the latter contained a ground squirrel (*Spermophilus tereticaudus*). Several were seen in the Santa Clara Valley, Utah, about the middle of May.

In the Panamint Mountains, California, Dr. Merriam observed it in Emigrant Cañon about the middle of April, and Mr. Bailey and the writer saw one soaring over the summit of Telescope Peak on June 23 and later in the day the former observer killed one near the 'charcoal kilns.' Its stomach contained one pocket gopher (*Thomomys*), two large lizards (*Cnemidophorus tigris* and *Sauromalus ater*), five grasshoppers, and one sand cricket (*Stenopalmatus*). In the northern part of the same mountains Mr. Nelson noted a few, and also in the White and Inyo mountains from the upper limit of the pines down to the valleys. In the Argus Range individuals were seen at Shepherd Cañon and Maturango Spring; and near the road to Lookout Mountain an adult was seen on June 25, beating back and forth over the rocky hillside, evidently hunting for the large lizards known as 'chuck-wallas' (*Sauromalus ater*), which were common in the locality.

It was observed in the Coso Mountains, and in Owens Valley it was found at a number of places, both in winter and summer. It was seen at Old Fort Tejon, Walker Pass, Walker Basin, South Fork of Kern River, and in the High Sierra at Sequoia National Park, Horse Corral, Cottonwood, and Whitney meadows, and Round Valley.

In the San Joaquin Valley it was observed at Bakersfield and Visalia. Mr. Bailey saw it at Monterey, and Mr. Stephens at Reche Cañon near San Bernardino. Mr. Nelson saw it everywhere about the Tehachapi and Temploa mountains and found it common all along the coast from San Simeon to Santa Paula in November and December.

Buteo lineatus elegans. Red-bellied Hawk.

This species was observed mainly in the San Joaquin Valley, where one was seen near an irrigating ditch at Bakersfield, July 18, evidently watching for frogs. At Visalia a fine adult was seen among the oaks, July 22, and at the same place on September 17 and 18 the species was not uncommon. Mr. Nelson reported it as abundant among the oaks on Kings River at the base of the foothills in August, and saw it near the Mission of Santa Ynez and in Gaviota Pass, in November.

Buteo swainsoni. Swainson's Hawk.

Swainson's hawk is apparently a rare species in the region traversed by the expedition. Mr. Nelson saw a number on the western foothills of the Sierra Nevada, and Dr. Merriam shot an adult male on Kern River near Kernville, June 23. Its stomach contained one grasshopper. Several were seen catching grasshoppers in the Cañada de las Uvas, California, June 28–29. At Walker Basin, California, Mr. Bailey and the writer saw a number, and on July 15 the latter observer killed an adult female whose stomach contained about fifty grasshoppers. In Walker Basin a species of grasshopper, which Prof. C. V. Riley kindly identified for the writer as *Camnula pellucida*, was very abundant. In many places a large part of the vegetation ordinarily available as food for these insects was dried up and had lost much of its original nutritive properties, so they had to seek elsewhere for subsistence. This they found in the form of fresh horse droppings which were strewn along the roads and in the corrals. Wherever this substance occurred vast numbers of grasshoppers congregated in a struggling mass, each individual striving to reach the interior of the throng so as to partake of the food. Not only the hawks, but most other birds in the valley, including ducks, ravens, woodpeckers, and sparrows, fed almost exclusively on the grasshoppers.

Archibuteo ferrugineus. Ferruginous Rough-leg.

Very few squirrel hawks were seen by the expedition. Mr. Nelson secured a specimen at Pahrump ranch, and saw others in Vegas and Pahrump valleys and Vegas Wash, March 3–16. A few were seen at Ash Meadows, Nevada, about the same time, but none were secured. Dr. Merriam saw a pair circling over the summit of the highest peak of Mount Magruder, Nevada, June 8, and several times afterward saw them hunting in company in the nut pine groves of the same mountains.

Aquila chrysaëtos. Golden Eagle.

The golden eagle was observed sparingly in a number of widely separated localities by different members of the expedition. One was seen at Ash Meadows, Nevada, March 18, circling over a shallow pond in which a large number of ducks were feeding. Mr. Nelson saw several in Vegas Valley and about the Charleston Mountains, Nevada, March 3–16, and Dr. Merriam saw three among the tree yuccas on the east side of Pahrump Valley, April 29, and one on the Charleston Mountains the following day. One was seen in the Juniper Mountains May 19, and another at Oasis Valley the 1st of June. In California Dr. Merriam observed a pair in Owens Valley, June 10–19, and he and Mr. Palmer saw one near Alamo ranch, in the Sierra Liebre, June 30. According to the Indians, this eagle breeds rarely in the higher portions of the Grapevine, Panamint, Inyo, and White mountains.

In the main Sierra Nevada one was seen on the east slope of Walker Pass, July 2; a pair on the South Fork of the Kern River, July 3–11; one near Little Cottonwood Creek, August 23; a number in Whitney Meadows; and several at and above timber line near Mineral King, September 8–11. At the latter place they probably fed on woodchucks (*Arctomys*) and grouse (*Dendragapus*).

Haliæetus leucocephalus. Bald Eagle.

Two adult bald eagles were seen sitting on a dead mesquite at Ash Meadows, Nevada, about the middle of March. They were the only ones noted during the season.

Falco mexicanus. Prairie Falcon.

Prairie falcons were seen in a number of localities throughout the desert regions as well as among the mountain ranges of southern California and Nevada. In Death Valley, between Bennett Wells and Furnace Creek, one was seen January 22, and at the latter place one was shot from its perch on a haystack where it sat watching a flock of Gambel's quail, January 27, and another was seen in summer on June 20. One was secured at Resting Springs in the Amargosa Desert, February 12, and another at Ash Meadows, Nevada, March 16. At the latter place, where ducks were abundant, this falcon was seen on several occasions to chase single birds, which escaped by dropping in the water among the tules. Mr. Nelson saw a number in Pahrump and Vegas valleys, Nevada, and at the Bend of the Colorado, and one was seen on a cliff in Vegas Wash eating a duck. In the Panamint Mountains one was shot from the top of a cut bank at the mouth of Johnson Cañon, March 26; others were seen in Emigrant Cañon, April 14–15, and in the higher mountains near Telescope Peak, April 17–19. Mr. Nelson found it sparingly about the bases of both the Panamint and Grapevine ranges, where old nests were found on the cliffs. In Nevada Dr. Merriam saw it on Mount Magruder, June 8; in Pahranagat Valley, May 22–26 (breeding in both the Pahranagat and Hyko mountains), and in the Virgin Valley near Bunkerville, May 8. In the Lower Santa Clara Valley, Utah, he saw a pair several times about the cliffs a short distance from the village of St. George, May 11–15.

In Panamint Valley it was seen at Hot Springs April 20, and in the lower end of the valley, January 12. A female was seen in the Coso

Mountains chasing doves, May 19. In Owens Valley the species was seen at a number of localities, and undoubtedly breeds in both the Inyo range and the Sierra Nevada. On the eastern slope of Walker Pass a pair of these falcons were seen flying along the hillsides where quail were abundant.

In the High Sierra a specimen was shot at Big Cottonwood Meadows, August 26; one was seen at Whitney Meadows in the same month, and another at the summit of the pass at the head of Kings River. Mr. Palmer noted the species at Old Fort Tejon, June 28; Mr. Nelson saw it occasionally in the San Joaquin Valley, October 5–27; and saw several along the route from San Simeon to Santa Maria in November, and a few at Cañada de las Uvas and up to the summit of the Temploa Mountains.

Record of specimens collected of Falco mexicanus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Valley, Calif	Jan. 12, 1891.	E. W. Nelson	
83	♂	Death Valley, Calif	Jan. 27, 1891.	A. K. Fisher	Furnace Creek.
110	♂	Resting Springs, Calif	Feb. 12, 1891.	....do	
131	♀	Ash Meadows, Calif	Mar. 16, 1891.	....do	
141	♂	Panamint Mountains, Calif	Mar. 25, 1891.	....do	Johnson Cañon.

Falco peregrinus anatum. Duck Hawk.

The only true duck hawk seen by the expedition was observed by Mr. Nelson near the coast west of San Luis Obispo, in November.

Falco columbarius. Pigeon Hawk.

The only records of the pigeon hawk made by the expedition are the following, all in California: Two seen by Mr. Stephens at Little Owens Lake early in May; the remains of one found by the writer near the reservoir at Furnace Creek, Death Valley, June 21; a few seen on the coast by Mr. Nelson between San Simeon and Carpenteria in November, and one in the Ojai Valley, Ventura County, in December.

Falco sparverius deserticolus. Desert Sparrow Hawk.

The sparrow hawk was common in but few places and was nowhere numerous as a summer resident. In Nevada it was not observed except at Ash Meadows, and in Pahrump and Vegas valleys, where it was found in March.

In California one was seen in Cajon Pass in the San Bernardino Mountains, January 1, and another, March 30. In Death Valley it was seen at Mesquite Well, January 21, Bennett Wells at the same date, and again about the middle of April; a pair among the cottonwoods at Furnace Creek, March 22, and one in Mesquite Valley, April 12.

In the Panamint Mountains, Dr. Merriam saw one in Emigrant Cañon, April 14, another on the north side of Telescope Peak, April 17–19, and Mr. Nelson found it rare in this range as well as in the Grapevine range in May. He found a pair nesting at the summit of the divide at the head of Cottonwood Creek in the former range, and a few in the Inyo

Mountains from the upper edge of the piñon belt up to the summit. In the latter range a pair occupied a cavity in a dead *Pinus flexilis* on the divide east of Lone Pine. Dr. Merriam saw a male on the summit of the White Mountains between Deep Spring Valley and Owens Valley, June 9, and Mr. Nelson saw the species in the same mountains and on the plateau at head of Owens Valley the following month.

In the Argus range, above Maturango Spring, a male was seen with a snake in its talons, which was carried to a height of several hundred yards and dropped, for what reason was not evident.

In Owens Valley the sparrow hawk was common at Lone Pine in December, 1890, and was found sparingly in the summer from Little Owens Lake to the head of the valley in the White Mountains. It was seen along the South Fork of Kern River, July 3–10; at Kernville, July 11-12, and was common in Walker Basin, where it was feeding on grasshoppers, July 13–16.

Mr. Palmer found it common on Peru Creek and in Castac Cañon, near Newhall, June 30, and in San Francisquito Pass, July 1. In the High Sierra it was seen at Menache Meadows, May 24–26; was common at Big Cottonwood Meadows during the summer; common at Whitney Meadows from below timberline to some distance above it during the last of August; at Round Valley, 12 miles south of Mount Whitney August 28; at Soda Springs or Kern River Lakes, early in September; and along the Kaweah River in August. Mr. Bailey found it common at Monterey, September 28 to October 9, and Mr. Stephens at Reche Cañon, September 22–24.

Mr. Nelson found it common in the San Joaquin Valley October 5–27 and abundant along the route from San Simeon to Carpenteria and Santa Paula in November and December.

It was common near San Luis Obispo, where one was seen with a small snake in its talons. It was sitting on a fence post eating the snake, and when startled flew off, carrying the reptile.

Record of specimens collected of Falco sparverius deserticolus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
33	♂	Sierra Nevada, Calif.	Aug. 12, 1891	B. H. Dutcher	Big Cottonwood Meadows.
439	♂	do	Aug. 28, 1891	A. K. Fisher	Round Valley.

Pandion haliaëtus carolinensis. Osprey.

The fish hawk was observed by Dr. Merriam in two localties, Death Valley, California, and Pahranagat Valley, Nevada. In the former place a single individual was seen at Furnace Creek just before dark on April 10. In Pahranagat Valley he saw several at the lake May 24, and in the evening of the same day shot one by mistake for an owl, as it hovered over the camp fire after dark.

At Furnace Creek a specimen was nailed upon the side of the house at the ranch, where it was killed a year or so before our arrival.

Strix pratincola. Barn Owl.

The only barn owl found east of the Sierra Nevada was a dead one seen by Mr. Stephens at Alvord, the last of June. Dr. Merriam and Mr. Palmer found the species abundant at Old Fort Tejon the latter part of June, where a family of young, in one of the large oaks near camp, proved a great nuisance on account of the hissing and shrieking which was kept up all night. The old birds were seen flying in and out among the large oaks on several occasions, as if in pursuit of bats. It is altogether likely that they were thus occupied, as the remains of this mammal have been found repeatedly among their stomach contents, both in Europe and this country. A pouched gopher and a chipmunk, left on the table, disappeared one night, probably through the agency of these birds.

On the South Fork of the Kern River Mr. Bailey secured two specimens July 4, and the species was common at Bakersfield and Visalia, in the San Joaquin Valley, in the latter part of July. Dr. Merriam found it common in the old mission of San Luis Rey, in San Diego County, and Mr. Stephens saw one in Reche Cañon, near San Bernardino. Mr. Nelson found it very common about San Emigdio, Morro Bay, and San Luis Obispo in October and November.

Record of specimens collected of Strix pratincola.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Kern River, Calif	July 4, 1891	V. Bailey	South Fork.
	♀	do	do	do	Do.
402	♀	Visalia, Calif	July 23, 1891	A. K. Fisher	

Asio wilsonianus. Long-eared Owl.

The long-eared owl was seen at a few places only. Mr. Nelson found a flock of eight living in a willow patch at Pahrump ranch, Nevada, February 12–28. All were flushed in an area less than 50 yards in diameter, and each bird had evidently occupied the same place for a considerable time, as the little groups of several dozen pellets plainly showed. Mr. Bailey secured a specimen at Bakersfield, in the San Joaquin Valley, July 18, and another near timber line north of Mineral King in the Sierra Nevada, September 9.

Asio accipitrinus. Short-eared Owl.

Several short-eared owls were seen at Ash Meadows, Nevada, during the early part of March, and Mr. Stephens shot a specimen in Temecula Cañon, San Diego County, California, January 30.

Syrnium occidentale. Spotted Owl.

This species was not met with by any member of our expedition, though the type came from Old Fort Tejon, California, where it was obtained March 6, 1858, by John Xantus.

Megascops asio bendirei. California Screech Owl.

No screech owls were seen or heard east of the Sierra Nevada in California. On the ridge above Walker Basin one was flushed from among the oaks July 14, but was not secured. At Bakersfield, in the San Joaquin Valley, the species was common and was heard at short intervals from dark to daylight, and Mr. Bailey secured a specimen about midnight of July 19, as it sat in the moonlight on a low limb over his bed. At Visalia, in the same valley, it was heard commonly among the big oaks July 22–24, and again September 17 and 18.

Mr. Nelson heard screech owls in different parts of the San Joaquin Valley in October, and along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Megascops asio bendirei.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
399	♂	Bakersfield, Calif	July 20, 1891.	A. K. Fisher	
403	♀	Visalia, Calif	July 24, 1891.	do	

Bubo virginianus subarcticus. Western Horned Owl.

Great horned owls were often heard and occasionally seen at different localities in California and Nevada—in the latter State at Ash Meadows and in the Grapevine and Charleston mountains.

In California, in the Panamint Mountains, it was heard almost nightly in Johnson and Surprise cañons during the first half of April, and by Dr. Merriam in Emigrant Cañon about the same time. In the Argus Range at Shepherd Cañon an individual on several occasions was seen to fly from a certain ledge, where it probably had young; and at Maturango Spring one was flushed from among some boulders on May 7. It was heard all along the South Fork of the Kern River, July 3–11, and at Walker Basin, where two started from a rocky ledge among the hills, and one secured, July 14. Its stomach contained the remains of a wood rat (*Neotoma*) and a scorpion. In the San Joaquin Valley the species was heard at Bakersfield and Visalia in the latter part of July, and in the High Sierra at Sequoia National Park, Horse Corral and Whitney meadows, Soda Springs, and along the Kaweah River, in August and September.

Mr. Bailey heard it at Monterey, September 28 to October 9, and Mr. Stephens at Reche Cañon, September 22–24. Mr. Nelson heard great horned owls in the Tehachapi and Temploa mountains, in the San Joaquin Valley, and secured a specimen near San Luis Obispo.

Record of specimens obtained of Bubo virginianus subarcticus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	im.	Soda Springs, Kern River, Calif	Aug. 13, 1891	V. Bailey	Fragments.
	♀	San Luis Obispo, Calif	Nov. 29, 1891	E. W. Nelson	

Speotyto cunicularia hypogæa. Burrowing Owl.

The burrowing owl was not met with in any great numbers east of the Sierra Nevada in California or in Nevada. In the latter State several were seen in Ash Meadows, and one was caught at the mouth of the hole of a kangaroo rat (*Dipodomys deserti*) in Oasis Valley in March. In California several were seen about badger holes at Daggett, on the Mohave Desert, January 8–10; a few at Granite Wells January 15 and April 5, and a pair at Lone Willow Spring April 25. Mr. Bailey saw a pair at Bennett Wells, in Death Valley, June 21. A pair was seen in Coso Valley, below Maturango Spring, May 11. In Owens Valley one was seen at Lone Pine June 11; a pair with young at Alvord June 26–29; one at Morans July 4–7, and a few at the head of the valley, near the White Mountains, in July. Mr. Stephens saw it at various places in Salt Wells Valley, where it probably was breeding, May 1–5, and Mr. Bailey and the writer found it common at Indian Wells, in the same valley, July 1. A pair was seen on the eastern slope of Walker Pass July 1, where one was caught in a trap the following morning. A number of times burrowing owls were caught in steel traps set at the holes of badgers, foxes, spermophiles, and kangaroo rats.

Dr. Merriam and Mr. Palmer saw several pairs with full-grown young in the upper part of the Cañada de las Uvas and near Gorman Station, at the west end of Antelope Valley, during the latter part of June and the first week of July. They were living in the burrows of Beechey's spermophile and were catching grasshoppers in the daytime. They saw the species also at Caliente June 24, and in Tehachapi Valley June 25. At Bakersfield, in the San Joaquin Valley, and on the dry plains between Bakersfield and Visalia it was abundant, and as many as a dozen or fifteen were often in sight at once, perched on the mounds in front of the burrows, or on the tops of the telegraph poles.

Mr. Nelson found it generally distributed in the lowlands bordering the coast, between San Simeon and Carpenteria.

Record of specimens collected of Speotyto cunicularia hypogæa.

Collectors' No.	Sex.	Locality.	Date.	Collector.	Remarks.
48	♀	Daggett, Calif	Jan. 10, 1891	A. K. Fisher	Mohave Desert.
49	♂	do	do	do	Do.
7	♀	do	Feb. 7, 1891	F. Stephens	Do.
62	♂	Granite Wells, Calif	Jan. 15, 1891	A. K. Fisher	Do.
163	♀	Mojave, Calif	Sept. 9, 1891	F. Stephens	35 miles northeast.
120	♂	Owens Valley, Calif	June 26, 1891	do	
	♀ im.	Walker Pass, Calif	July 2, 1891	V. Bailey	
31	♂	Oasis Valley, Nev	Mar. 15, 1891	F. Stephens	

Geococcyx californianus. Road-runner.

The road-runner or chaparral cock is tolerably common in many of the desert and foothill regions visited by members of the expedition, but on account of its more or less retiring habits comparatively few were seen, though their tracks were common. In Nevada it was very common along the sand dunes and mesquite patches at Ash Meadows, as well as in Vegas Valley and at the Bend of the Colorado, in March, and Mr. Stephens heard it in Oasis Valley.

In California the species is resident in Death Valley, as its numerous tracks seen around the mesquite and other thick growths at Furnace Creek during January and in June conclusively demonstrate.

At Resting Springs in the Amargosa Desert, where it was tolerably common, Mr. Bailey caught one in a steel trap, February 12, and Mr. Nelson found indications of its presence in Mesquite and Saline valleys. In Owens Valley it was very common, judging from the tracks; Mr. Nelson found it common and secured a specimen at Lone Pine in December, 1890; and Dr. Merriam saw one three miles south of that town, June 18, and others at the lower end of the valley on the following day. He saw one in Walker Pass June 22, and Mr. Bailey secured a specimen in the same place July 3. Several were seen along the South Fork of Kern River and at Kernville, June 22–23 and July 3–15, and near Alamo ranch in the Sierra Liebre, June 30. Dr. Merriam saw two near the north end of Cajon Pass in the San Bernardino Mountains, March 29, and found it common in the southern part of San Diego county in Escondido and San Marcos valleys, where it was breeding in patches of branching cactus.

In the Cañada de las Uvas, Mr. Palmer saw one near Castac Lake July 9, and shot one the following day at Old Fort Tejon. In the San Joaquin Valley tracks were seen frequently in the river bottoms and along the borders of thickets near Bakersfield in July, and Mr. Nelson found it common about the foothills at the south and west sides of the valley, October 5–27. The same observer found it along the coast from Morro to Carpenteria in November, and Mr. Bailey at Monterey, September 28 to October 9.

Record of specimens collected of Geococcyx californianus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Resting Springs, Calif.	Feb. 12, 1891	V. Bailey	
	♂	Walker Pass, Calif.	July 3, 1891	....do	

Coccyzus americanus occidentalis. California Cuckoo.

At Furnace Creek ranch in Death Valley, a cuckoo was seen among the willows at the edge of the reservoir about sunrise on June 20, and later in the day Mr. Bailey succeeded in securing it (an adult female). In the San Joaquin Valley the species was common at Bakersfield July 17–20, and was heard several times at Visalia among the live oaks July 22–25. In Owens Valley, Mr. Stephens saw one August 11, two miles west of Bishop. No others were recorded.

Ceryle alcyon. Belted Kingfisher.

A kingfisher was seen at San Bernardino, Calif., December 29, 1890. The species was not again met with until the party reached Ash Meadows, Nevada, where a few were seen along the streams during the early part of March. One was seen by Mr. Burnett at Furnace Creek, Death Valley, flying about the reservoir, April 15. Dr. Merriam saw one at Hot Springs, Panamint Valley, April 20, and another in Vegas Wash, Nevada, near the Colorado, May 2.

At Lone Pine, in Owens Valley, it was not uncommon along the river, and Mr. Stephens noted it at Alvord, in the same valley, the last of June. In the Sierra Nevada it was not uncommon at Soda Springs or Kern River lakes, the first of September, and was noted at Three Rivers, in the western foothills, about the middle of the month. Mr. Nelson observed it at the head of the Merced and San Joaquin rivers, and later saw a few individuals along the Kern River, in San Joaquin Valley, in October, and along the streams flowing into the sea between San Simeon, Carpenteria, and Santa Paula, in November and December. Mr. Bailey found it common at Monterey September 28 to October 9.

Dryobates villosus hyloscopus. Cabanis's Woodpecker.

Cabanis's woodpecker was found nowhere common in California, and was not observed at all in Nevada. One was seen above Johnson Cañon in the Panamint Mountains, April 18; Dr. Merriam observed several on the north side of Telescope Peak in the same range, April 17–19, and Mr. Nelson found the species very rare in the northern part of the Panamint and Grapevine Mountains during May and the first part of June. In the Coso Mountains it was seen on several occasions during the last half of May; in the upper part of the Inyo Range a few were seen the last of June; and others on the summit of the White Mountains June 9.

In the Sierra Nevada a few were seen on the east slope, at the head of Owens River, in July; several at Bishop Creek August 4–11; and the species was rather common at Menache Meadows May 24–26. Several were seen on the western slope of Walker Pass July 2; a number along the valley of Kern River July 3–10; and they were not uncommon in Walker Basin, from the bottom of the valley to summit of the ridge, July 13–16. Several were seen in the Sequoia National Park during the first week in August; a few at Horse Corral Meadows August 9–13; one was observed in Kings River Cañon August 15; the species was common at Big Cottonwood Meadows through the summer, at Whitney Meadows September 1, and several were noted from timber line down to below Mineral King September 10–13.

In the Cañada de las Uvas Mr. Palmer saw one or two back of Old Fort Tejon July 6, and a number near the summit of Frazier Mountain July 9.

At Monterey Mr. Bailey found a race of the hairy woodpecker, probably the present subspecies, common from September 28 to October 9; and Mr. Nelson found it sparingly at Mount Piños in October, and in the mountains between San Simeon and Carpenteria November 4 to December 18.

Record of specimens collected of Dryobates villosus hyloscopus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂ ad.	White Mountains, Calif	June 9, 1891	V. Bailey	
365	♀ im.	Walker Pass, Calif	July 2, 1891	A. K. Fisher	
275	♂ im.	Kern River, Calif	July 5, 1891	....do	South Fork.
143	♀ im.	Sierra Nevada, Calif	July 27, 1891	F. Stephens	
38	♂ im.	....do	Aug. 11, 1891	B. H. Dutcher	Big Cottonwood Meadows.
31	im.	....do	....do	....do	Do.

Dryobates pubescens gairdnerii. Gairdner's Woodpecker.

Dr. Merriam shot a specimen of this species on the north side of Tehachapi Pass, California, a few miles below the summit, June 25. Mr. Nelson found it rare in the piñon belt of the Panamint and Grapevine mountains May 4 to June 15, and reported a few seen near San Luis Obispo the last of October. These are the only records we have for the species.

Dryobates scalaris bairdi. Baird's Woodpecker.

The known range of this woodpecker was extended considerably by the observations of the expedition. In the Mohave Desert it was not uncommon among the giant yuccas at Hesperia, east of Cajon Pass, where a pair was secured January 4 and 5. Dr. Merriam saw one at the Upper Cottonwood Springs at the east base of the Charleston Mountains, Nevada, April 30, one in Vegas Wash May 2, another near the mouth of the Santa Clara, Utah, May 14, and shot an adult male and saw others in the cottonwoods where Beaverdam Creek joins the Virgin in northwestern Arizona, May 9.

In 1889 Mr. Bailey found it common in the timber along the Santa Clara in January, among the yuccas at Dolan and Mud springs in Detrital Valley, Arizona, in February, and in the river bottom at Fort Mohave in March.

Record of specimens collected of Dryobates scalaris bairdi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Beaverdam, Ariz	May 9, 1891	C. Hart Merriam	
33	♂	Hesperia, Calif	Jan. 4, 1891	A. K. Fisher	
41	♀	....do	Jan. 5, 1891	....do	

Dryobates nuttallii. Nuttall's Woodpecker.

This species was first observed in Cajon Pass in the San Bernardino Mountains, Calif., where a fine adult male was secured January 2. Mr. Palmer saw several at Old Fort Tejon, July 1, and Dr. Merriam secured a specimen between Walker Basin and Caliente, June 24. In the Sierra Nevada several were seen on the western slope of Walker Pass, July 2—13; it was not uncommon along the valley of Kern River

July 3–13; was common at Walker Basin, July 13–16; and at Three Rivers it was not uncommon, and was found along the East Fork of the Kaweah River as high as the lower edge of the conifers. It was seen on several occasions at Bakersfield, in the San Joaquin Valley, July 17–20; and Mr. Nelson saw several around San Emigdio, and a few along the coast from San Simeon to Carpenteria in November and December, 1891.

Record of specimens collected of Dryobates nuttallii.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
20	♂	Cajon Pass, Calif.	Jan. 2, 1891	A. K. Fisher	
366	♂ im	Walker Pass, Calif.	July 2, 1891	....do	

Xenopicus albolarvatus. White-headed Woodpecker.

The white-headed woodpecker was rather common in the higher parts of the Sierra Nevada, in California. Mr. Nelson noted a few at the head of Owens River, and found it common on the divide between the Merced and San Joaquin rivers, on the western slope. In the Sequoia National Park it was common, going in pairs and frequenting the more open pine woods. Several were seen at Horse Corral Meadows, August 9–13, and in Kings River Cañon, August 15.

It was seen also at Big Cottonwood Meadows, August 26; at Whitney Meadows the last of August; at Soda Springs or Kern River Lakes, September 3; and along the East Fork of the Kaweah River, from the lower edge of the pines to and above Mineral King, the last of July and September 13–14. Mr. Palmer saw one in Tejon Pass, July 12, and Mr. Nelson observed several near the summit of Mount Piños, in October.

Record of specimens collected of Xenopicus albolarvatus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Sierra Nevada, Calif.	July 30, 1891	V. Bailey	East Fork of Kaweah River.
408	♂	......do	Aug. 6, 1891	A. K. Fisher	Sequoia National Park.

Sphyrapicus varius nuchalis. Red-naped Sapsucker.

The single record of this woodpecker is a male, killed by Mr. Nelson among the piñons on the west slope of the mountains northwest of Charleston Peak, Nevada, February 12, 1891.

Sphyrapicus ruber. Red-breasted Sapsucker.

The red-breasted woodpecker was not met with east of the Sierra Nevada. Mr. Palmer secured a specimen at Halsted Meadows, in the Sequoia National Park, where it was not uncommon, August 3. It was common at Horse Corral Meadows, around the edges of clearings and in the willow clumps, August 9–13; was seen at Soda Springs or Kern

River Lakes by Mr. Bailey and the writer in August and September; and on the Kaweah River, below the pines, September 12. Mr. Nelson noted it at the head of Owens River and on the western slope, where it was rather more common. He also saw a few at Mount Piños about the middle of October, and Mr. Palmer saw a few in Tejon Pass, July 12.

Record of specimens collected of Sphyrapicus ruber.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
146	♂	Sierra Nevada, Calif	July 24, 1891	F. Stephens	
412	♂ ad.	do	Aug. 12, 1891	A. K. Fisher	Horse Corral Meadows.
413	♂ im.	do	do	do	Do.
	♂ im.	do	do	V. Bailey	Kern River Lakes.

Sphyrapicus thyroideus. Williamson's Sapsucker.

Williamson's woodpecker is not uncommon in a number of places in the Sierra Nevada, in California. Mr. Nelson saw one at the head of Owens River, and a few on the western slope opposite that place. Several were seen at Horse Corral Meadows, August 11–13; at Whitney Meadows about September 1; and the species was common at Big Cottonwood Meadows, August 25–27, where Mr. Dutcher killed several earlier in the season. It was noted at Soda Springs or Kern River Lakes, early in September; at Mineral King, the last of July and the second week in September, and was seen once on Mount Piños about the middle of October.

Record of specimens collected of Sphyrapicus thyroideus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
410	♂	Sierra Nevada, Calif	Aug. 11, 1891	A. K. Fisher	Horse Corral Meadows.
	im.	do	Aug. 2, 1891	V. Bailey	Mineral King.
27	♂ im.	do	Aug. 4, 1891	B. H. Dutcher	Big Cottonwood Meadows.
28	♂ im.	do	do	do	Do.
29	im.	do	do	do	Do.
421	♂	do	Aug. 26, 1891	A. K. Fisher	Do.
156	♂ im.	do	Aug. 21, 1891	F. Stephens	Olancha Peak.

Ceophlœus pileatus. Pileated Woodpecker.

This handsome woodpecker was not observed except in the Sierra Nevada, in California, where Mr. Nelson found it common at an altitude of about 1980 meters (6,500 feet) in the Mariposa grove of big trees near Wawona and along the Merced River. The writer heard it a number of times in the Sequoia National Park early in August, and Mr. Palmer saw a pair in Kings River Cañon, August 14.

Melanerpes formicivorus bairdi. California Woodpecker.

The California woodpecker was not seen east of the western slope of the Sierra Nevada. Dr. Merriam found it in Walker Basin June 24; in

Tehachapi Pass, June 25; and in the Cañada de las Uvas, where it was breeding abundantly, June 28–29. At Three Rivers, in the foot hills, the species was common July 25–30, and September 14–17, at which time it was feeding on acorns.

In Walker Basin the writer saw several families along a fence row where they were feeding on grasshoppers, July 13–16, and on the 14th the species was common among the pines on the ridge above the valley.

All along the road between Tulare and Visalia in the San Joaquin Valley, this woodpecker was common among the oaks, July 22–24. As many as ten individuals were seen in one tree.

Mr. Nelson found it common and generally distributed among the oaks in the San Joaquin Valley, and along the route from San Simeon to Santa Paula, during the last three months of the year.

Record of specimens collected of Melanerpes formicivorus bairdi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
389	♂	Walker Basin, Calif.	June 14, 1891	A. K. Fisher	
401	♂	Visalia, Calif.	July 23, 1891	do	

Melanerpes torquatus. Lewis's Woodpecker.

This woodpecker was quite common in Walker Basin, where it was seen June 24 and July 13–16. The birds were stationed along the fence rows and on trees, from which they made frequent excursions to the ground to capture grasshoppers. The stomachs of a number examined contained nothing but the remains of this insect.

It was seen by Dr. Merriam and Mr. Palmer near Old Fort Tejon, in the Cañada de las Uvas, the latter part of June. Mr. Nelson saw one on the plateau at the head of Owens Valley in July and on the east slope of the Sierra at the head of Owens River in the latter part of July. At Three Rivers, in the western foothills, it was common among the oaks September 12–17.

Record of specimens collected of Melanerpes torquatus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
388	im	Walker Basin, California	July 13, 1891	A. K. Fisher	
	im	do	do	V. Bailey	
	♂ im	do	do	do	
	♀ ad	do	do	do	

Melanerpes uropygialis. Gila Woodpecker.

A specimen of this woodpecker was taken by Mr. Bailey near Fort Mohave, Ariz., in March, 1889.

Colaptes cafer. Red-shafted Flicker.

The red-shafted flicker was seen in many places, though it was comparatively rare over the greater part of the country traversed.

In Nevada, Mr. Nelson saw this woodpecker in Pahrump and Vegas valleys during the latter part of February and first of March. Mr. Stephens observed it in the Grapevine Mountains March 20–26 and found it common at the Queen mine July 11–16. Dr. Merriam saw two in the nut pine zone on Mount Magruder June 6, and the writer shot an individual, the only one seen, at Ash Meadows, March 2. At Pahrump ranch, Mr. Nelson saw where one had drilled four holes through the boards in the gable end of a building used as a granary, and each time a piece of tin had been placed over the hole. When he was there, the bird had just completed a fifth hole, close to the others.

In California, it was common just outside of the town of San Bernardino the last of December, 1890, and was observed in Cajon Pass January 1–2. At Hesperia, in the Mohave Desert, a number were seen among the tree yuccas January 3–4.

Mr. Nelson found the species in the Inyo Mountains the latter part of June, and stated that it occurred wherever there was moisture enough to support a growth of the higher pines in the mountains or of cottonwoods in the valleys. He also found it common from the head of Owens Valley up to timber line in the White Mountains in July. Dr. Merriam saw a red-shafted flicker at Furnace Creek, in Death Valley, April 10, among the willows and mesquite; one at Hot Springs, Panamint Valley, about April 20, and another in the Panamint Mountains a few days earlier. In the Argus Range, the writer saw one at Maturango Spring May 14, several in the Coso Mountains during the latter part of the same month, and a number in the higher portions of the Panamint Mountains the last week in June. In Owens Valley, it was seen by Mr. Nelson at Lone Pine, in December, 1890, and by Mr. Stephens at Independence Creek, Bishop Creek, and Benton during the summer.

This woodpecker was not uncommon in Walker Pass, along the valley of the Kern River, at Kernville, and in Walker Basin during the first half of July. On the High Sierra it was seen in the Sequoia National Park the first week in August; at Horse Corral Meadows August 9–13; in Kings River Cañon August 13–16; at Menache Meadows May 24–26; at Big Cottonwood Meadows June 15 to September; at Whitney Meadows the last of August; Soda Springs or Kern River Lakes, August and first part of September; and at Mineral King and down the west slope to Three Rivers in the foothills during the first two weeks in September.

Dr. Merriam saw it in the Cañada de las Uvas June 28–29, and the writer observed it at Bakersfield July 17–20. Mr. Bailey recorded the species from Monterey September 20 to October 9, and Mr. Nelson reported it common in the Tejon Mountains, in the San Joaquin Valley, at San Luis Obispo, and along the route between San Simeon and Carpenteria during the fall and early winter.

Phalænoptilus nuttalli. Poor-will.

The poor-will was common in a number of localities visited by the expedition. In Death Valley a specimen was obtained at Bennett Wells January 28, another at Saratoga Springs February 4; and the species was seen and heard by Dr. Merriam at Furnace Creek April 10, and in Mesquite Valley April 13. One was seen in the Funeral Mountains March 21. At Ash Meadows, Nevada, one or two were seen and others heard during the first part of March. In Nevada Dr. Merriam found it common on Mount Magruder June 4–9, where he saw and heard one or more every evening and obtained a specimen. On Gold Mountain he heard it at the deserted mining camp June 3, in Pahranagat Valley May 22–26, at Sheep Spring in the Juniper Mountains, May 18, and at Vegas ranch May 1. In Utah he heard it along Shoal Creek, near the Escalante Desert, May 17.

Mr. Nelson found the species in the Panamint and Grapevine mountains, where it was a rare breeder in the sage-brush belt. He saw and heard a few from the bottom of Saline Valley up to the piñons in the Inyo Mountains, found it as high as 2,650 meters (8,700 feet) in the White Mountains, and also on the plateau at the head of Owens Valley. In Owens Valley a specimen was taken at the mouth of the cañon at Lone Pine, June 12; Mr. Stephens saw two at Olancha May 16–23, and others at Independence Creek June 18–23, and at the Queen mill and mine, Nevada, July 11–16. The same observer saw one at Borax Flat, near the southern end of the Argus Range, the last of April. Mr. F. W. Koch collected two fresh eggs May 6 above Maturango Spring, where it was common. At Coso it was heard or seen every evening during the latter half of May. It was common at Hot Springs in Panamint Valley, April 10–25; and at Wild Rose Spring, in the Panamint Mountains, June 25.

Record of specimens collected of Phalænoptilus nuttalli.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Death Valley, Calif	Jan. 28, 1891	E. W. Nelson	Bennett Wells.
	♂	......do	Feb. 14, 1891	....do	Saratoga Springs.
246	♂	Coso Mountains, Calif	May 22, 1891	A. K. Fisher	
337	♀	Owens Valley, Calif	June 12, 1891	....do	Lone Pine.
41	♂	Grapevine Mountains, Calif	Apr. 1, 1891	F. Stephens	Grapevine Spring.
	♀	Mount Magruder, Nev	June 4, 1891	C. Hart Merriam	

Phalænoptilus nuttalli californicus. California Poor-will.

This race of the poor-will was common in Kern Valley, where Mr. Bailey secured a specimen July 8. One was seen on the road from Kaweah to the Sequoia National Park July 31. It would await until the horse nearly stepped on it, then fly ahead some distance and alight on the road again, which manœuver it repeated several times. Mr. Bailey saw a poor-will at Trout Meadows in the High Sierra, which probably belonged to this race. Dr. Merriam shot one at Twin Oaks, at the foot of the Granite range, in San Diego County, July 10, where several were observed to alight in the same place every evening in a dusty road under the spreading branches of a live-oak tree.

Record of specimens collected of Phalænoptilus nuttalli californicus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Kern River, Calif.	July 8, 1891	V. Bailey	South Fork.
		Twin Oaks, San Diego County, Calif.	July 10, 1891	C. Hart Merriam	

Chordeiles virginianus henryi. Western Nighthawk.

It is a source of great regret that specimens of nighthawks were not secured at the various places where they were found by the members of the expedition. This neglect makes it impossible to properly separate the range of the present from that of the following species in the region under consideration.

The only specimen of the western nighthawk secured was one collected by the writer in Death Valley, at Furnace Creek, June 19. At this place the nighthawks began to fly just after sunset and were very common over the alfalfa fields at the ranch. Nighthawks supposed to belong to this species were seen in Pahranagat Valley, Nevada, May 22–26, on Mount Magruder, Nevada, June 4–8, and in the High Sierra, at Trout, Whitney, and Big Cottonwood meadows, during the summer and autumn.

Chordeiles texensis. Texas Nighthawk.

Fortunately, a larger number of specimens of this night-hawk was taken than of the preceding species, though not enough to enable the satisfactory mapping of its distribution in California and Nevada.

The Texas nighthawk was a very common breeder in most parts of Owens Valley, where it occurred as far north at least as Bishop. Around Owens Lake and Lone Pine large numbers were observed every night, and at the former place many were seen skimming close to the water in pursuit of a small fly (*Ephydra hians*), which was swarming on and near the shore.

The species was not uncommon along the South Fork of the Kern River, where Mr. Bailey secured a specimen July 8, and at Bakersfield, in the San Joaquin Valley, where several were seen and one secured about the middle of the month.

Dr. Merriam saw it during the breeding season in Oasis Valley and Ash Meadows, Nev., and at other points in the Amargosa Desert, and also in the Mohave Desert, in California. He saw one at Saratoga Springs at the south end of Death Valley, April 26, and two at Resting Springs in the Amargosa Desert, April 27. He found it common at the mouth of Beaverdam Creek, Arizona, May 9, and secured two fresh eggs at St. George, in the Lower Santa Clara Valley, Utah, May 13. Another was shot in the Virgin Valley, near the eastern boundary of Nevada, May 8. Nighthawks which probably belonged to this species were seen in Pahrump and Vegas valleys, Nevada, and Saline Valley, California. This nighthawk had the habit of alighting on the dusty roads, just at dusk, where it sat motionless for a time, though in a few instances it was observed to make a series of hopping flights, alighting at short intervals for a moment only.

Record of specimens collected of Chordeiles texensis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Beaverdam Creek, Ariz.	May 10, 1891	V. Bailey	
125	♀	Owens Valley, Calif.	June 29, 1891	F. Stephens	Bishop.
319	♂	do	June 8, 1891	A K. Fisher	Lone Pine.
327	♀	do	June 10, 1891	do	Do.
335	♀	do	June 12, 1891	do	Do.
336	♂	do	do	do	Do.
	♀	do	June 13, 1891	C. Hart Merriam	Do.
285	♀	do	June 2, 1891	A. K. Fisher	Keeler.
69	♂	do	May 31, 1891	F. Stephens	Ash Creek.
	♂	Kern River, Calif.	July 8, 1891	V. Bailey	South Fork.
398	♀	Bakersfield, Calif.	July 19, 1891	A. K. Fisher	

Cypseloides niger. Black Swift.

The black swift was first observed at Owens Lake near Keeler, Calif., where a number were seen flying back and forth over the salt meadows on May 31. On June 2, twenty or more were seen feeding over the same meadow and five specimens were collected. From the condition of the ovaries of the female secured, it was evident that the eggs had been laid. When the flock left the marsh, it rose high in the air and went in the direction of the cliffs in the Inyo Mountains, near Cerro Gordo, where a colony evidently was breeding. Near the upper end of the lake, and about 6 miles north of Keeler, several were seen on June 4 and again on June 15. At Lone Pine, five passed over camp early on the morning of June 7, and a number were seen at the mouth of the cañon above the town June 12. Dr. Merriam saw a number and secured one at the north end of Owens Lake, June 12, and saw half a dozen at Olancha, at the south end of the lake, June 20. Mr. Stephens saw a dozen or more at the latter place May 23 and secured two June 4. On the former date they were flying high out of range, in company with white-throated swifts and white-bellied swallows. The same observer saw this species at Independence Creek, June 20, and at Bishop Creek, August 6.

On the South Fork of Kern River three swifts were seen which undoubtedly belonged to this species, and on several occasions black swifts were seen in Kings River Cañon, August 13–16.

Record of specimens collected of Cypseloides niger.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
279	♂	Keeler, Inyo County, Calif.	June 2, 1891	A. K. Fisher	
280	♂	do	do	do	
281	♂	do	do	do	
282	♀	do	do	do	
	♀	do	do	T. S. Palmer	
	♂	Owens Lake, Calif.	June 12, 1891	C. Hart Merriam	
73	♂	do	June 4, 1891	F. Stephens	Olancha.
74	♂	do	do	do	Do.

Chætura vauxii. Vaux's Swift.

Vaux's swift was seen a few times only in the valleys on each side of the Sierra Nevada. Mr. Stephens saw it nearly every day and secured a specimen at Olancha, near the south end of Owens Lake, where it was migrating, May 16–23.

Mr. Belding saw large flocks in the Yosemite Valley. The writer saw a few at Three Rivers, in the western foothills of the Sierra, September 13–14, and at Visalia on September 18.

Aëronautes melanoleucus. White-throated Swift.

White-throated swifts were common at a number of places in the desert valleys and ranges during the spring and summer. In Johnson Cañon, in the Panamint Mountains, Calif., Mr. Palmer saw one March 26, and Mr. Nelson secured one near the same place, April 12. The latter observer found the species to be a common summer resident in portions of the Panamint and Grapevine mountains visited. The last of May he saw them going in and out of crevices in the steep walls above Willow Creek, and in June found them frequenting the cliffs in Cottonwood Cañon, 750 meters (2,500 feet) above Salt Wells, and observed them about the cliffs in Boundary Cañon in the Grapevine Range. They were frequently seen in the morning and evening hunting over Saline Valley. In the Panimint Mountains north of Telescope Peak, Mr. Bailey and the writer saw several hundred of these swifts flying back and forth over a hillside, and a few above the summit of the peak, June 23. The males uttered at short intervals a series of notes which, when a number joined in the performance, produced a not unpleasant impression. In Death Valley Dr. Merriam saw a flock at Mesquite Wells, April 8; Mr. Burnett saw individuals flying over the reservoir at Furnace Creek, April 15; and the writer killed a number of specimens at the latter place, June 20. In the Argus Range swifts were seen in Shepherd Cañon the last of April, and along the divide above Maturango Spring during the first half of May.

In Nevada Dr. Merriam saw several at Pahroc Spring, May 22; at Ash Meadows, May 30; and in Oasis Valley and the upper part of Amargosa Desert, June 1, when they were observed in aërial coition. In Utah Dr. Merriam saw several small flocks in the Lower Santa Clara Valley, May 11–15. Mr. Nelson found it breeding in the Inyo Mountains, Calif., June 24–July 4, and sparingly in the White Mountains in July. White-throated swifts were common in many places in Owens Valley, especially about the meadows at Owens Lake and at the mouth of the cañons. Along the South Fork of the Kern River they were tolerably common the first week in July, and a few were seen flying over the Sequoia National Park the first week in August. Mr. Nelson found them at the head of Owens River; also along all the streams visited on the western slope of the Sierra, and in the Yosemite Valley up to timber line. They bred everywhere in crevices in the cañon walls. He saw several flocks in the Ojai Valley in December.

Record of specimens collected of Aëronautes melanoleucus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint Mountains, Calif	Apr. 11, 1891	E. W. Nelson	
43	♀	Death Valley, Calif	Apr. 9, 1891	F. Stephens	Furnace Creek.
345	♀	......do	June 20, 1891	A. K. Fisher	Do.
346	♀	......do	....do	....do	Do.
347	♀	......do	....do	....do	Do.
	♂	Keeler, Calif	June 2, 1891	T. S. Palmer	
95	♂	Owens Lake, Calif	June 12, 1891	F. Stephens	Olancha.

Trochilus alexandri. Black-chinned Hummingbird.

The black-chinned hummingbird is common in Owens Valley, California, where it was found at the following localities: At Lone Pine a number of specimens were secured in June; At Olancha Mr. Stephens found it common, May 16–23; at Ash Creek, May 30–June 3; a few at Independence Creek, June 18–23; Alvord, June 26–28; and young of the year were common at Fish Slough, July 2–3. At Olancha he secured a very interesting specimen which in its specific characters was intermediate between this species and Costa's hummer, and was probably a hybrid. He found a nest containing three eggs in an orchard at the same place, May 16. Mr. Nelson found it common on both slopes of the Inyo Mountains from the valleys up to the piñons, wherever there was water enough to produce a growth of willows and other deciduous trees. In Walker Basin, where it was not common, Mr. Bailey secured a specimen, July 14, and another was taken at Bakersfield in the San Joaquin Valley, July 19. At Old Fort Tejon Mr. Palmer secured an immature bird in July, which he referred to this species.

Dr. Merriam saw several and secured two at the mouth of Beaverdam Creek, Arizona, May 9, and found the species common in the Lower Santa Clara Valley, Utah, where four nests containing fresh eggs were found, May 11–14. All the nests (one of which contained three eggs) were placed on low branches of cottonwoods, generally within easy reach from the ground.

Record of specimens collected of Trochilus alexandri.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Santa Clara, Utah	May 11, 1891	C. Hart Merriam	
	♂	Beaverdam Creek, Ariz	May 9, 1891	V. Bailey	
58	♀	Owens Valley, Calif	May 16, 1891	F. Stephens	Olancha, set 3 eggs.
65	♂	......do	May 20, 1891	....do	Ash Creek,
80	♂	......do	June 10, 1891	....do	Olancha.
	♂	Walker Basin, Calif	July 14, 1891	V. Bailey	
400	♀	Bakersfield, Calif	July 19, 1891	A. K. Fisher	
311	♂	Owens Valley, Calif	June 7, 1891	....do	Lone Pine.
312	♂	......do	....do	....do	Do.
314	♂	......do	June 8, 1891	....do	Do.

Calypte costæ. Costa's Hummingbird.

Costa's hummingbird is the common species of the desert valleys and mountains of southern California and Nevada. One was seen at

Resting Springs in the Amargosa Desert, California, February 13; a number were seen in the Funeral Mountains March 22; at Furnace Creek, Death Valley, April 12; and in Emigrant Cañon, in the Panamint Mountains, April 14. It was common in Johnson and Surprise cañons, where it was seen near all the springs and streams during April, and in the latter cañon a half-completed nest was found April 19. Several were seen at Hot Springs in Panamint Valley, April 19–25, and at Leach Point Spring April 25. Costa's hummingbird was the only species met with by Mr. Nelson in the Panamint and Grapevine Mountains, where he found it a common breeder, during May and June.

In Nevada, Dr. Merriam found it tolerably common on Mount Magruder June 4–8; in Pahranagat Valley May 22–25; at Mountain Spring, Charleston Mountains, and at Upper Cottonwood Springs at the eastern base of these mountains, April 30. In Vegas Wash he found a nest containing two full-fledged young May 3; at the Bend of the Colorado one containing two fresh eggs May 4; and at Bitter Spring in the Muddy Mountains, another containing two fresh eggs, May 5. Mr. Nelson saw one in Vegas Wash, Nevada, March 10; and Mr. Stephens reported it from the Grapevine Mountains and Oasis Valley from the middle to the latter part of the month. Dr. Merriam found it common among the junipers on the eastern side of the Beaverdam Mountains, Utah, May 11.

In the Argus Range, California, the species was very common at Maturango Spring, and in Shepherd Cañon, where several nests were found in the low bushes along the edges of the cañon. Those containing two fresh eggs each were taken April 27, April 28, and May 7, and one containing full-fledged young, April 27. At Coso the species was very abundant and several of its nests were found. Various kinds of plants were used as nesting sites, though the branching cactus (*Opuntia echinocarpa*) was most commonly chosen. Usually the structure was placed on the top of a lower branch, a foot or so from the ground, and under an overhanging mass of thick spiny branches, which formed a protection for the parent bird from the sun and weather, as well as its enemies. At Coso one of these hummers was seen on a bright moonlight evening hovering about a bunch of flowers, and was heard again later in the same night. During our last trip to Death Valley Mr. Bailey saw one at Furnace Creek June 19, and the species was abundant all through the Panamint Mountains. Just at daylight on the morning of June 25, before the shadow had risen out of Wild Rose Cañon, a Costa's hummingbird came and hovered within a foot of our camp fire, probably mistaking it from the distance for a bunch of bright flowers. It was observed on several occasions that any bright-colored object placed in a conspicuous position attracted this bird. In Owens Valley this hummingbird was more or less common, especially along the eastern slope of the Sierra Nevada, where it was associated with the black-chinned hummer. Several were seen on the eastern slope of Walker Pass July 1, and in Reche Cañon September 22–24.

The male Costa's hummingbird has a peculiar habit, prol closely associated with the season of courtship, of flying up i air to a considerable height and then swooping down with grea locity until near the ground, when it rises to its former positio repeat the manœuver fifteen or twenty times before settling on perch to rest. The course taken by the bird forms a parabolic c and when on the descent a booming, rushing noise is made, which be heard at a considerable distance.

Record of specimens collected of Calypte costa.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks
59	♂	Owens Valley, Calif	May 20, 1891	F. Stephens	Olancha. Hyb tween *T. cos* *T. alexandri.*
68	♀	do	May 31, 1891	do	Ash Creek. of nest and e
139	♂	Panamint Mountains Calif	Mar. 26, 1891	A. K. Fisher	Johnson Caño
155	♂	do	Apr. 14, 1891	do	Surprise Caño
163	♂	do	Apr. 16, 1891	do	Do.
166	♂	do	Apr. 20, 1891	do	Do.
167	♂	do	do	do	Do.
	♂	do	Mar. 27, 1891	E. W. Nelson	Johnson Caño
	♂	do	Mar. 28, 1891	do	Do.
	♂	do	April 4, 1891	do	Do.
	♂	do	Apr. 11, 1891	do	Do.
	♂	do	Apr. 14, 1891	do	Surprise Caño
	♀	do	May 12, 1891	do	
	♀	do	May 23, 1891	do	Willow Creek ent of nest an
192	♀	Argus Range, Calif	Apr. 29, 1891	A. K. Fisher	Shepherd C Parent of No
191	♂ juv.	do	do	do	Shepherd Cañ
204	♀	do	May 7, 1891	do	Shepherd C Nest and egg
268	♀	Coso Mountains, Calif	May 28, 1891	do	Nest and eggs
	♂	Ash Meadows, Nev	May 30, 1891	V. Bailey	
	♂	Charleston Mountains, Nev	Apr. 30, 1891	do	
	♂	Panaca, Nev	May 19, 1891	do	

Calypte anna. Anna's Hummingbird.

A large hummer was seen in the Cajon Pass in the San Bernai Mountains on January 2, which was probably this species. Mr. Step saw a number, mostly immature males, on the side of Reche Ca September 22–24; Mr. Bailey found the species common at Mont where he secured specimens October 3 and 6, and Mr. Nelson fou common at Morro Bay, and saw a few south of that place in Noven

Record of specimens collected of Calypte anna.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remark
	♂	Monterey, Calif	Oct. 3, 1891	V. Bailey	
	♂	do	Oct. 6, 1891	do	

Selasphorus platycercus. Broad-tailed Hummingbird.

The broad-tailed hummer was found by Dr. Merriam at Sheep Sp in the Juniper Mountains, Nevada, where an adult male was sec and many others seen May 19. Mr. Nelson reported it as commo the western slope of the Sierra Nevada, California, opposite the head of Owens River, and Mr. Palmer secured a specimen in the Sequoia National Park August 4.

Selasphorus rufus. Rufous Hummingbird.

The Rufous hummingbird was seen only in the Sierra Nevada, in California. Mr. Nelson found it common at the head of Owens River, and on the western slope from timber line down into the Yosemite Valley. While crossing the divide between the heads of the San Joaquin and Merced rivers he saw a number of these birds crossing from the latter to the former river. The species was common in the Sequoia National Park, where a specimen was taken August 4; and at Horse Corral Meadows August 9–13; one was seen in Kings River Cañon August 15, and one at Kearsarge Pass August 18.

At Mineral King it was common from above timber-line down to the lower part of the pines early in August and again in September. It was unusually common on the south side of Farewell Gap, on September 8, where large numbers were observed flying about in the attempt to dry and warm themselves, after a cold rain and hail storm.

Stellula calliope. Calliope Hummingbird.

None of our party obtained this hummingbird. Mr. Belding observed it at Crocker's, near the Yosemite Valley, in May 1891, and Dr. W. J. Hoffman reported it from Owens Valley, where it was found breeding in July. "One nest with eggs was found perched over and within a short distance of a noisy mountain stream, where it was no doubt frequently subjected to the dashing spray" (Bull. U. S. Geol. and Geog. Sur., Hayden, VI, 1881, 237).

Mr. Henshaw saw a single individual in the Tejon Mountains, August 17, 1875.

Tyrannus tyrannus. Kingbird.

At Olancha, near the southern end of Owens Lake, Mr. Bailey and the writer saw a common kingbird, June 29. It was so near that identification was positive. The Arkansas flycatchers seemed to be ill disposed towards the stranger and were chasing and diving at it whenever it took wing.

Tyrannus verticalis. Arkansas Kingbird.

The Arkansas flycatcher was common in most of the valleys traversed by the expedition. In California one was seen at Raymond Well, in Salt Wells Valley, and another in the Coso Valley, May 1, in which latter place it became common a few days later. Mr. Nelson saw a few in Panamint, Saline, and Mesquite Valleys, in May and June; near the valleys on both slopes of the Inyo Mountains, the last of June; and at the head of Owens Valley, near the White Mountains, in July. In Owens Valley, it was common at Lone Pine, where many young were seen June 4–15; at Olancha, June 29; at Big Pine, June 26–28; and more or less common at various other places in the valley throughout the summer. Dr. Merriam found it breeding commonly in the tree yuccas in Antelope Valley at the west end of the Mohave Desert, June 26–27, and saw one at Resting Springs in the Amargosa Desert, April 27. At Walker Pass a pair was seen on the east slope July 1, and the species was common on the west slope the following day. It was common also along the valley of Kern River July 3–13; at Walker Basin, July 13–16; at Bakersfield, in the San Joaquin Valley, July 17–20, and at Three Rivers and along the lower part of the Kaweah River, the last of July. Mr. Palmer found it abundant at Old Fort Tejon in July, and Mr. Nelson saw several near Nordhoff the last of December.

In Nevada, Dr. Merriam saw it on Gold Mountain, June 3; found it tolerably common in Pahranagat Valley May 22–26; in Meadow Creek Valley, May 19; in the Valley of the Virgin near Bunkerville, May 8; at the Bend of the Colorado, May 4; at Vegas Ranch, May 1; and at Yount's ranch in Pahrump Valley, April 29. In the Lower Santa Clara Valley, Utah, he found it breeding and tolerably common, May 11–15.

Record of specimens collected of Tyrannus verticalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Vegas Valley, Nev	May 1, 1891	C. Hart Merriam	
205	♀	Argus Range, Calif	May 7, 1891	A. K. Fisher	Maturango Spring.
225	♂	do	May 11, 1891	do	Do.
304	♂	Owens Valley, Calif	June 6, 1891	do	Lone Pine.
91	♂	do	June 12, 1891	F. Stephens	Olancha.
92	♀	do	do	do	Do.

Tyrannus vociferans. Cassin's Kingbird.

Dr. Merriam found this flycatcher breeding commonly among the live oaks at Twin Oaks, in western San Diego County, in the early part of July and secured a specimen July 10. One was seen at San Bernardino January 1.

Myiarchus cinerascens. Ash-throated Flycatcher.

The ash-throated flycatcher is a common resident of the desert regions of southern California, Nevada, Utah, and northern Arizona, and is common also west of the Sierra Nevada. In California it was first seen in Panamint Valley, at Hot Springs, where it arrived April 22 and became common almost immediately. In the Argus Range it was common in Shepherd Cañon and at Maturango Spring, where it was seen along the hillsides, hovering over the flowers in search of small moths and other insects, during the first half of May. At Coso several pairs were seen, and an individual was observed to devote considerable time to examining the open end of a 2-inch water pipe, which protruded from the side of an old building, evidently with an idea of using it for a nesting site. Mr. Nelson found it a widely distributed species, breeding from the bottom of Mesquite, Panamint, and Saline valleys, up to at least 2,130 meters (7,000 feet) in the Panamint and Grapevine mouns, where it appeared to be equally at home on the open slopes of valleys, among the mesquite and larrea bushes, or in the mountains, ie midst of a tolerably abundant growth of piñons. He found it ding as high as the upper border of the piñons in the Inyo Moun- s the last of June.

Nevada Dr. Merriam saw it in the tree yuccas on the east side of rump Valley, April 29; at the Bend of the Colorado, May 4; near kerville, in the Valley of the Virgin, May 8; on the west slope of Juniper Mountains, May 19; in Pahranagat Valley, May 23; on the pahute Mountains, May 26; found it common among the yuccas in an Spring Valley, May 28; on the south side of Gold Mountain, e 3; and tolerably common and evidently breeding among the nut s on Mount Magruder, June 4–8. In Utah he found it breeding monly in the Santa Clara Valley, May 11–15, and among the tree as on the west side of the Beaverdam Mountains, May 10. In hwestern Arizona he saw several at the mouth of Beaverdam k the same day. On the summit connecting the White and Inyo ntains, in California, several were seen on June 9.

t Furnace Creek, Death Valley, a pair of these birds was seen just e the ranch at the mouth of the cañon, June 21, and the species not uncommon in the Panamint Mountains up to an altitude of e than 2,450 meters (8,000 feet). In Owens Valley it was not un- mon at Lone Pine, June 4–15; at Olancha, May 16–23; at Ash Creek, 30–June 3; and at Benton, July 9–10.

was seen among the tree yuccas in Walker Pass, June 22 and July was common in the valley of the Kern, July 3–13; abundant in ker Basin, June 24 and July 13–16; in Tehachapi Pass, June 25; in the Cañada de las Uvas, June 28. A few were seen among the oaks in the Granite Range in the western part of San Diego nty, July 1–10. It was common at Bakersfield, July 17–20, and at e Rivers, July 25–30.

Record of specimens collected of Myiarchus cinerascens.

s	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Valley, Calif.	Apr. 22, 1891	C. Hart Merriam	Hot Springs.
1	♂	......do	Apr. 23, 1891	A. K. Fisher	Do.
5	♂	Owens Valley, Calif.	June 6, 1891	....do	Lone Pine.
1	♀	......do	June 13, 1891	F. Stephens	Olancha.

rnis saya. Say's Phœbe.

y's phœbe is a common species throughout the desert regions, and also found west of the Sierra Nevada. It was common in the vicin- f Owens Lake in December, 1890; was seen near Daggett, in the ave Desert, January 10, 1891, and at Lone Willow Spring, January In Death Valley, it was observed at Bennett Wells and Furnace k the latter part of January; again, April 9–12 and June 19–22.

In Nevada it was observed at Ash Meadows in March, sparingly in Pahrump and Vegas valleys, and thence down to the Bend of the Colorado, and was rather common and mating in Oasis Valley in the same month. Dr. Merriam found it in Fish Lake Valley, June 8; on the north slope of Gold Mountain, June 3; at the east end of Grapevine Cañon, June 2, where a nest was observed in an old well at an abandoned mining shaft known as Thorp's mill; in Ash Meadows, where a nest was found in an old adobe, May 30; in Pahranagat Valley, May 22–26; at Pahroc Spring, May 22; at the Bend of the Colorado, May 4; and in the Virgin Valley near Bunkerville, May 8. He saw two at the mouth of Beaverdam Creek, Arizona, May 9–10, and in Utah found it common in the lower Santa Clara Valley, breeding along the cliffs near St. George, May 10–11, and among the junipers on the eastern slope of the Beaverdam Mountains, May 10–11.

In the Panamint Mountains the species was not seen in Johnson Cañon, but was common in Surprise Cañon, where a nest and eggs was found April 19, and also at Hot Springs, in Panamint Valley, April 20–25. Mr. Nelson found it commonly distributed in the bottoms of Saline, Panamint, and Mesquite valleys, ranging up in the Panamint and Grapevine mountains. He found the species breeding in various sheltered places, such as holes in clay banks, niches in rocky ledges, sides of old walls, and in crevices in deserted mining shafts. In the Argus Range it was common in Shepherd Cañon and at Maturango Spring, and at Coso a nest containing three nearly grown young was found in one of the deserted buildings the last of May. The species was found in the Inyo Range up to and among the piñons, and was a rather common breeding species in Owens Valley.

Several were seen in Walker Pass, July 1–3. Say's phœbe was common through Kern River Valley, July 3–13, and occurred in Walker Basin in about equal numbers with the black phœbe, July 13–16. One was seen at timber line near Mineral King, September 10, and the species was observed along the route to Three Rivers, September 12–16. Mr. Bailey found it common at Monterey, September 28 to October 9, and Mr. Stephens at Reche Cañon, near San Bernardino, September 22–24.

Mr. Nelson found it common and generally distributed along the coast from San Simeon to Carpenteria and Santa Paula, in November and December, and sparingly in the San Joaquin Valley, October 5–27.

Record of specimens collected of Sayornis saya.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
71	♂	Death Valley, Calif	Jan. 24, 1891	A. K. Fisher	Furnace Creek.
76	♂	do	Jan. 25, 1891	do	Do.
	♀ im.	do	June 19, 1892	V. Bailey	Do.
12	♀	Daggett, Calif	Feb. 8, 1891	F. Stephens	
257	♂ juv.	Coso, Mountains, Calif	May 26, 1891	A. K. Fisher	
102	♂ im.	Owens Valley, Calif	June 15, 1891	F. Stephens	Olancha.

Sayornis nigricans. Black Phœbe.

The black phœbe was rare in the desert regions east of the Sierra Nevada, though more or less common west of this range. At San Bernardino one was seen among some willows, associated with other birds, December 28, 1890. It was seen in Cajon Pass, March 30; at Furnace Creek, Death Valley, April 12; at Hot Springs, in the Panamint Valley, April 22; and in the Argus Range, at Shepherd Cañon, April 27. Mr. Stephens found a pair apparently breeding at Little Owens Lake the first week in May, and an immature individual at Bishop Creek, August 4–10. On the western slope, it was common along the valley of Kern River, near the water, July 3–13; common and in about equal numbers with Say's phœbe, at Walker Basin, July 13–16; common in the Cañada de las Uvas, June 28–29; and in the Sierra Liebre, June 30. It was common at Bakersfield, in the San Joaquin Valley, in July; at Three Rivers, in the foothills, July 25–30 and September 13–16; and in Kings River Cañon, August 13–16. Mr. Bailey saw one at timber line near Mineral King, August 4, and found it common at Monterey, September 18 to October 9. Mr. Nelson observed it commonly about San Emigdio, sparingly along the southern and western sides of the San Joaquin Valley, commonly and in about equal numbers with Say's phœbe along the coast from San Simeon to Carpenteria, and not numerous between Carpenteria and Santa Paula, in November and December.

Contopus borealis. Olive-sided Flycatcher.

The olive-sided flycatcher was found nowhere common. Mr. Nelson observed it migrating in considerable numbers at the head of Willow Creek in the Panamint Range, during the third week in May. The same observer found it on the east side of the Sierra Nevada, at the head of Owens River, from an altitude of 2,500 to 2,900 meters (8,200 to 9,500 feet), and on the west slope up to 3,050 meters (10,000 feet).

In the Sierra Nevada Mr. Stephens found it at Menache Meadows, May 24–26; Mr. Dutcher secured two specimens and reported it as more or less common at Big Cottonwood Meadows; and Mr. Bailey saw several at an altitude of about 2,650 meters (8,700 feet) near Mineral King, and secured a brood of young just able to fly, August 4.

The writer secured a specimen in the Coso Mountains, California, May 23; Dr. Merriam observed one on the south side of Gold Mountain, Nevada, June 3; and Mr. Palmer saw one near the summit of Frazier Mountain, California, July 9.

Record of specimens collected of Contopus borealis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Mountains, Calif	May 21, 1891	E. W. Nelson	
248	♂	Coso Mountains, Calif.	May 23, 1891	A. K. Fisher	
8	♀	Sierra Nevada, Calif.	June 23, 1891	B. H. Dutcher	Big Cottonwood Meadows.
26	♂	do	Aug. 4, 1891	do	Do.
	♂	do	do	V. Bailey	Mineral King.
	im	do	do	do	Do.

Contopus richardsonii. Western Wood Pewee.

The western wood pewee was a common species in many of the localities visited. Mr. Nelson found it a rather common breeding bird in Cottonwood, Willow Creek, and Mill Creek cañons in the Panamint Mountains, Calif., and saw it also in the Grapevine Mountains, Nevada.

In Coso Valley, California, it first appeared May 16, and by May 25 was common in the Coso Mountains. It was common all through Owens Valley, and on the White Mountains. At Keeler, on the east side of Owens Lake, it was not uncommon the 1st of June. One day when the wind was very high, a number were seen sitting on the bare alkaline flats near the lake, where they were picking up from the ground the flies which swarmed there, as grain-eating birds do seeds. On the summit of the divide in the White Mountains, between Deep Spring Valley and Owens Valley, Dr. Merriam killed two June 9. At Old Fort Tejon it was common about the 1st of July.

It was common in Walker Pass, where a nest was observed, July 2; at Kernville, July 11; Walker Basin, July 13–16; and at Bakersfield, in the San Joaquin Valley, July 17–20. In the High Sierra it was not uncommon in the Sequoia National Park, the first week in August; at Horse Corral Meadows, August 9–13; Kings River Cañon, August 13–16; Big Cottonwood Meadows, during the summer; at Menache Meadows, May 24–26; and was common along the Kaweah River from Mineral King down to Three Rivers, in September.

In Nevada, Dr. Merriam saw it among the cottonwoods at Vegas ranch, May 1; at Pahranagat Valley, May 23 (common); at Oasis Valley, June 1; and on Mount Magruder, June 8. He also saw the species at the mouth of Beaverdam Creek, Arizona, May 10.

Record of specimens collected of Contopus richardsonii.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
251	♀	Coso Mountains, Calif	May 24, 1891	A. K. Fisher	
6	♂	Sierra Nevada, Calif	June 19, 1891	B. H. Dutcher	Big Cottonwood Meadows.
89	♀	Owens Lake, Calif	June 12, 1891	F. Stephens	
	♀	White Mountains, Calif	June 9, 1891	V. Bailey	
	♂	do	do.	do	
	♂	Mount Magruder, Nev	June 4, 1891	do	

Empidonax difficilis. Western Flycatcher.

The western flycatcher was seen in a few localities only. Dr. Merriam secured an adult male at Ash Meadows, Nevada, May 30, and a female at Mount Magruder in the same State, June 5. Mr. Palmer reported the species as common and secured one at Old Fort Tejon, July 6. Mr. Nelson saw it along the San Joaquin River in August, but does not state how common it was.

Record of specimens collected of Empidonax difficilis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂ ad.	Ash Meadows, Nev	May 30, 1891	V. Bailey	
	♀	Mount Magruder, Nev	June 5, 1891	C. Hart Merriam	

Empidonax pusillus. Little Flycatcher.

In a few localities the little flycatcher was not rare. Dr. Merriam found it tolerably common where Beaverdam Creek joins the Virgin River in northwestern Arizona, May 9, and in Pahranagat Valley, Nevada, May 22–26.

In Owens Valley, California, Mr. Stephens found it a rather common migrant at Olancha, May 16–23, and the writer secured two specimens in a willow thicket along Owens River, at Lone Pine, June 11. Mr. Palmer shot one near Old Fort Tejon July 3, and Mr. Nelson saw a few among the willows along streams from 2,940 to 2,900 meters (9,000 to 9,500 feet) altitude, in the White Mountains, in the same month.

Record of specimens collected of Empidonax pusillus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Pahranagat Valley, Nev	May 23, 1891	C. Hart Merriam	
77	♀	Owens Valley, Calif	June 9, 1891	F. Stephens	Olancha.
80	♀	do	June 12, 1891	do	Do.
223	♂	do	June 11, 1891	A. K. Fisher	Lone Pine.
224	♂	do	do	do	Do.

Empidonax hammondi. Hammond's Flycatcher.

Hammond's flycatcher was seen in two localities only. In the Argus Range several were seen and two secured among the piñons above Maturango Spring on May 8. Dr. Merriam secured a specimen in Pahranagat Valley, Nevada, May 23.

Record of specimens collected of Empidonax hammondi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
258	♀	Argus Range, Calif	May 8, 1891	A. K. Fisher	Maturango Spring.
259	♂	do	do	do	Do.
	♀	Pahranagat Valley, Nev	May 23, 1891	C. Hart Merriam	

Empidonax wrightii. Wright's Flycatcher.

Wright's flycatcher was the only one of the small flycatchers found in winter in any of the region traversed. Mr. Nelson secured a specimen at Hot Springs in Panamint Valley, January 3, and the writer obtained one in the same place April 22. A specimen was secured among the willows at the edge of the reservoir at Furnace Creek, Death Valley, February 1, and two small flycatchers, probably this species, were seen there about the middle of April.

A specimen was secured in the Argus Range, at Maturango Spring May 5, and another was seen in Shepherd Cañon a few days before. In Owens Valley Mr. Stephens found the species at Olancha about the middle of May, and at Bishop Creek August 4–10. In the High Sierra it was seen at Big Cottonwood Meadows, August 29; at Whitney Meadows, August 20; and at Kern River Lakes or Soda Springs September 5. Dr. Merriam secured a specimen in the Virgin Valley in eastern Nevada, May 6.

Record of specimens collected of Empidonax wrightii.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Valley, Calif	Jan. 3, 1891	E. W. Nelson	
95	♀	Death Valley, Calif	Feb. 1, 1891	A. K. Fisher	Furnace Creek.
180	♂	Panamint Valley, Calif	Apr. 23, 1891	....do	Hot Spring.
50	♀	Argus Range, Calif	Apr. 26, 1891	F. Stephens	
198	♀	......do	May 5, 1891	A. K. Fisher	Maturango Spring.
	♀	......do	May 12, 1891	T. S. Palmer	Do.
		St. Thomas, Nev	May 6, 1891	V. Bailey	
	im.	Sierra Nevada, Calif	Aug. 20, 1891	....do	Whitney Meadows.

Pyrocephalus rubineus mexicanus. Vermilion Flycatcher.

Dr. Merriam shot an adult female of this species at St. George, in the Lower Santa Clara Valley, Utah, May 13. She was killed in an orchard at Dodge Spring, about a mile from the settlement, and contained large ova nearly ready for the shell. This record extends the known range of the species very materially, since it had not previously been recorded north of Fort Mohave, Arizona.

Otocoris alpestris arenicola. Desert Horned Lark.

So far as specimens go, this race of the horned lark was the only one found breeding east of the Sierra Nevada in the region traversed by the expedition. A flock of twenty or more was seen at Hesperia, in the Mohave Desert, January 4, and the subspecies also was seen in the same desert at Daggett January 8–10, and Granite Wells January 13–15. Dozens were seen by Dr. Merriam, who traveled over the same ground during the latter part of March and first week in April. In January Mr. Nelson saw about one hundred at the southern end of Panamint Valley. Horned larks were not seen at any time in Death Valley.

In Nevada they were common at Ash Meadows, in the plowed fields and sand plains, and about the middle of March had mated and were preparing to nest. In Pahrump and Vegas valleys Mr. Nelson found small parties in February and March. Dr. Merriam found it common in Meadow Creek Valley May 19; in Desert and Pahroc valleys May 20–22; in the valley between Gold Mountain and Mount Magruder June 4, where it was common and two nearly full grown young were shot; on Mount Magruder, June 4–8, where it was common on the sage plain on top of the mountain. In Utah, it was not seen i[illegible] the Santa Clara Valley, but several were observed in Mountain Meadows May 17.

In the north end of Panamint Valley, Mr. Nelson saw several the last of May, and others on the high tableland between Saline and Panamint valleys, in May and June. Dr. Merriam found it common in the sage brush north of Telescope Peak, April 15. Horned larks were found during the breeding season in the sage plains on the Inyo and White mountains, and in Saline and Deep Spring valleys. Below Maturango Spring, in Coso Valley, it was quite common May 11, and others were seen along the valley as far north as Darwin. In Owens Valley, the subspecies was found as a summer resident from the lower to the upper end. Mr. Palmer found it very abundant in Antelope Valley, and a few near Gorman Station the last of June.

Record of specimens collected of Otocoris alpestris arenicola.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
227	♂	Coso Valley, Calif	May 11, 1891	A. K. Fisher	
228	♂	do	do	do	
229	♀	do	do	do	
6	♂	Mohave Desert, Calif	Feb. 7, 1891	F. Stephens	Daggett.
52	♂	do	Jan. 13, 1891	A. K. Fisher	Granite Wells.
53	♂	do	do	do	Do
54	♀	do	do	do	Do
55	♂	do	do	do	Do
56	♂	do	do	do	Do
57	♂	do	do	do	Do
	♂	do	Apr. 25, 1891	V. Bailey	Leach Point Valley.
		do	June 27, 1891	T. S. Palmer	25 miles southwest of Mojave.
31	♂	Salt Wells Valley, Calif	Apr. 29, 1891	F. Stephens	Borax Flat.
126	♂	Ash Meadows, Nev	Mar. 14, 1891	A. K. Fisher	
136	♂	do	Mar. 19, 1891	do	
	♀	do	do	E. W. Nelson	
	♂	Pahrump Valley, Nev	Feb. 17, 1891	do	
	♂	do	do	do	
	♂	Indian Spring Valley, Nev.	May 28, 1891	V. Bailey	
	♂	Panaca, Nev	May 19, 1891	do	
	♂ im.	Gold Mountain Valley, Nev	June 4, 1891	C. Hart Merriam	Valley between Gold Mountain and Mount Magruder.
	♂ im.	do	do	do	
	♀	Mount Piños, Calif	Oct. 16, 1891	E. W. Nelson	San Rafael Mountains.
38	♂	Owens Valley, Calif	June 1, 1891	F. Stephens	Ash Creek.
43	♀	do	June 10, 1891	do	Olancha.
270	♂	do	May 31, 1891	A. K. Fisher	Keeler.
271	♀	do	June 1, 1891	do	Do.
288	♂	do	June 2, 1891	do	Do.
289	♀	do	do	do	Do.
290	♂	do	June 3, 1891	do	Do.
132	♀	do	Aug. 16, 1891	F. Stephens	Do.
134	♀ juv.	do	do	do	Do.
135	im.	do	July 20, 1891	do	Casa Diablo Spring.
136	♀	do	July 21, 1891	do	Do.
	♂	White Mountains, Calif	July 12, 1891	E. W. Nelson	
137	♂	Darwin, Calif	May 5, 1891	A. K. Fisher	
	♂	Coso Valley, Calif	May 11, 1891	T. S. Palmer	Maturango Spring.
	♂	do	do	do	Do.

Otocoris alpestris chrysolæma. Mexican Horned Lark.

Mr. Nelson obtained a number of specimens of this race at Keeler, on the shore of Owens Lake, December 28, 1890, though specimens taken at the same place during the breeding season are referable to *arenicola*. Mr. Stephens took one in the Panamint Mountains in April, and Mr. Bailey secured a specimen at Kernville, where the subspecies was common, July 13. The birds seen by Mr. Nelson in the San Joaquin Valley and in the vicinity of the Cañada de las Uvas probably should be referred to this race. He found it excessively abundant on the San Joaquin Plain, where it is locally known as the 'wheat bird' in the grain districts, owing to its habit of following the farmer and eating the newly-sown wheat at seeding time.

Record of specimens collected of Otocoris alpestris chrysolæma.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
44	♂	Panamint Mountains, Calif	Apr. 15, 1891	F. Stephens	5,200 feet altitude.
	♂	Kernville, Calif	July 13, 1891	V. Bailey	
	♂	Owens Valley, Calif	Dec. 28, 1890	E. W. Nelson	Keeler.
	♂	do	do	do	Do.
	♂	do	do	do	Do.
	♂	do	do	do	Do.
	♂	do	do	do	Do.
	♀	do	do	do	Do.
	♀	do	do	do	Do.

Pica pica hudsonica. Black-billed Magpie.

Mr. Bailey saw three individuals of this species 10 miles east of Toquerville, Utah, December, 31, 1888. The black-billed magpie was not seen by the expedition, but is known to be a common resident in the neighborhood of Carson, in western Nevada.

Pica nuttalli. Yellow-billed Magpie.

The Yellow-billed magpie is common in a number of places west of the Sierra Nevada, in California. At Visalia, several were seen among the oaks, July 23, as well as along the route from that place to Three Rivers, July 25. Near Cottage post-office, in Tulare County, about half-way between these two places, the species was common September 17.

Mr. Nelson found it common in the foothills of the Sierra Nevada, in August; and also among the oaks from La Panza to San Luis Obispo, October 28 and November 3; and from the latter place to the Santa Ynez River, beyond which places it was not noted.

Cyanocitta stelleri. Steller's Jay.

Steller's jay was met with along the coast of California, in two localities only. Mr. Bailey found it common in the thick woods in the vicinity of Monterey, where he secured a pair, October 1; and Mr. Nelson observed a few in the mountains near San Simeon in November.

Record of specimens collected of Cyanocitta stelleri.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Monterey, Calif	Oct. 1, 1891	V. Bailey	
	♀	do	do	do	

Cyanocitta stelleri frontalis. Blue-fronted Jay.

The blue-fronted jay was not found in the desert ranges, although it was common in many places along the east slope of the Sierra Nevada, in California. Mr. Nelson found it common at the head of Owens River at an altitude of from 2,500 to 2,900 meters (8,200 to 9,500 feet), and Mr. Stephens found it at Bishop Creek, August 4–10, and at Menache Meadows, May 24–26. The writer secured one among the pines above Walker Basin, July 14; found it common in Sequoia National Park the first week in August; at Horse Corral Meadows, August 9–13; in Kings River Cañon, August 13–16; and Big Cottonwood Meadows, Round Valley, and Whitney Meadows, the last of the month. It was very common among the sugar and yellow pines at Soda Springs or Kern River Lakes, the first week in September. Mr. Dutcher found it common during the breeding season at Big Cottonwood Meadows, and Mr. Bailey and the writer found it common at Mineral King and down along the Kaweah River to the lower limit of the pines, in September. Mr. Palmer reported it common on Frazier Mountain, near Old Fort Tejon, July 6.

Record of specimens collected of Cyanocitta stelleri frontalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
22	♂	Owens Lake, Calif	June 7, 1891	F. Stephens	Altitude, 4,000 feet.
141	♂	Sierra Nevada, Calif	July 25, 1891	...do	
17	im.	...do	July 12, 1891	B. H. Dutcher	Big Cottonwood Meadows.
	♂ im.	...do	Aug. 3, 1891	E. W. Nelson	South Fork Merced River.
299	♀	Walker Basin, Calif	July 14, 1891	A. K. Fisher	
409	♂ im.	Sierra Nevada, Calif	Aug. 7, 1891	...do	Sequoia National Park.
434	♀	...do	Sept. 3, 1891	...do	Soda Springs.

Aphelocoma woodhousei. Woodhouse's Jay.

Woodhouse's jay was found on all the desert ranges which furnish a growth of piñon or junipers. In California it was observed in the White Mountains, Inyo, Argus, Coso, and Panamint ranges; in Nevada, in the Charleston, Grapevine, Juniper, and Pahroc mountains, and in Utah, in the Beaverdam Mountains. In the latter part of June, young which were able to fly were found among the willows along the streams in the Panamint Mountains, north of Telescope Peak.

Record of specimens collected of Aphelocoma woodhousei.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
39	♂	Grapevine Mountains, Nev	Mar. 24, 1891	F. Stephens	
147	♀	Panamint Mountains, Calif	Mar. 29, 1891	A. K. Fisher	Johnson Cañon.
172	♂	...do	Apr. 20, 1891	...do	Surprise Cañon.
173	♀	...do	...do	...do	Do.
255	♀ im.	...do	June 23, 1891	...do	Wild Rose Cañon.
256	♀ im.	...do	...do	...do	
		Inyo Mountains, Calif	June 27, 1891	E. W. Nelson	
	im.	White Mountains, Calif	July 8, 1891	...do	

Aphelocoma californica. California Jay.

The California jay was not found east of the Sierra Nevada, it being replaced in the desert ranges by Woodhouse's jay. Although abundant on the west slope of the main Sierra, it was common in few places on the east side. Mr. Stephens found it rather common on the latter slope at Independence Creek, June 18–23; at Menache Meadows, May 24–26; and Mr. Nelson, at the head of Owens River, in the latter part of July.

The species was common in Cajon Pass in the San Bernardino Mountains, January 2–3, where it was seen and heard among the chaparral at all times of the day. Dr. Merriam found it common in the Sierra Liebre, San Bernardino, Tejon, and Tehachapi ranges, as well as in the southern Sierra from Walker Pass southward. It was tolerably common on the west slope of Walker Pass, June 21 and July 2–3; in the valley of Kern River, June 21–22 and July 3–13; thence southward to Havilah and Caliente, June 23–24; and was abundant and noisy at Old Fort Tejon late in June and early in July.

Dr. Merriam found it common in the coast ranges south of the San Bernardino plain, and in large numbers in the Granite Range between Twin Oaks and Escondido, Calif., early in July.

In the San Joaquin Valley it was common at Visalia and up along Kaweah River to the lower edge of the pines, in August and September, and a few were seen in the Sequoia National Park during the first week of August. Mr. Bailey found it common in the brush and open woods at Monterey, Calif., September 28 to October 9.

Mr. Nelson reported this jay as abundant in the Tejon and Temploa mountains and around San Luis Obispo in October, and along the route from San Simeon to Carpenteria and Santa Paula, in November and December.

Record of specimens collected of Aphelocoma californica.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
62	♀	Owens Valley, Calif.	May 23, 1891	F. Stephens	Olancha.
	♂	Walker Pass, Calif.	July 3, 1891	V. Bailey	
363	♀ im.	do	July 2, 1891	A. K. Fisher	
383	♀	Kern River, Calif.	July 9, 1891	do	South Fork.

Corvus corax sinuatus. Raven.

Ravens were seen in more or less abundance in most, if not all, of the localities visited by members of the expedition, from above timber line on the High Sierra to the bottom of Death Valley and the other desert valleys, and undoubtedly breed in all the desert ranges of southern California and Nevada. Ravens were seen in Cajon Pass in the San Bernardino Mountains, and on the Mohave Desert during the first week in January. At Daggett fifty or more remained about the slaughter house feeding on the refuse. In Death Valley they were observed by every party that visited the place from the first week in January to the last in June. In the Coso Mountains, two adults with their five young were seen flying high in the air May 25, the old birds being readily distinguished by their worn primaries.

In Nevada they were common at Ash Meadows and Pahrump Valley, and at the latter place a pair was secured the last of February. Dr. Merriam observed one, together with a large nest, on the shelf of a high cliff in Vegas Wash, May 3. He found ravens tolerably common about the Bend of the Colorado, May 4, and saw several in the Valley of the Virgin, near Bunkerville, May 8; others in the Juniper Mountains, May 19; in Desert Valley, May 20, and in Pahranagat Valley, May 22–26. In Utah he found several pairs in the Lower Santa Clara Valley, May 11–15, and thence northward to Mountain Meadows, where several were seen May 17.

Ravens were common all through Owens Valley. At Walker Basin flocks of several hundred were observed every day flying about the fields and roads, feeding on the grasshoppers which occurred in vast numbers there. All the specimens shot had nothing in their stomachs except the remains of these insects. Dr. Merriam and Mr. Palmer observed large numbers catching grasshoppers in the western part of the Mohave Desert, known as Antelope Valley, June 27–28, and near Gorman Station no less than forty-four were seen catching grasshoppers on the grassy hillsides at one time.

In the High Sierra ravens were seen at Menache, Whitney, and Big Cottonwood meadows, and at the head of Owens River. Mr. Nelson saw a few about Mount Piños and at Buena Vista Lake in October, and found them sparingly along the route from San Simeon to Carpenteria and Santa Paula, in November and December.

Record of specimens collected of Corvus corax sinuatus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Lone Willow Spring, Calif	Jan. 14, 1891	E. W. Nelson	
113	♀	Pahrump Valley, Calif	Feb. 24, 1891	A. K. Fisher	
114	♂	do	do	do	

Corvus americanus. Crow.

At one place only was the common crow seen by any member of the expedition east of the Sierra Nevada. In Pahrump Valley, Nevada, a flock of crows kept around the ranch during February and March.

At Bakersfield, in the San Joaquin Valley, crows were common along the river bottoms, in flocks of from five to fifty, July 17–20. Crows were observed among the oaks at Visalia, July 23, and a flock of about one hundred was seen and a specimen secured near Three Rivers, the latter part of the same month. Dr. Merriam saw a flock of half a dozen in Tehachapi Valley, California, June 25, and Mr. Palmer found them common at Tejon ranch, where they were feeding on figs, early in July. At Monterey, Mr. Bailey heard them cawing in the grounds of the Hotel Del Monte, September 28 to October 9. Mr. Nelson found crows common in the San Joaquin Valley in October, along the route from San Simeon to Carpenteria, and in the Ojai Valley in November and December.

Picicorvus columbianus. Clarke's Nutcracker.

Clarke's crow was common in the High Sierra in California, as well as in a few of the higher desert ranges to the eastward. It was numerous about the camp in the Charleston Mountains, Nevada, in February. In the Panamint Mountains, California, a solitary individual was seen near the top of the ridge south of Telescope Peak, April 2, and on the north slope of the same peak several were heard, June 23. A pair was seen later in the same day which, from their actions, appeared to be parent and young. Mr. Nelson found it rather common among the *Pinus flexilis* on the Inyo Mountains, and in the same belt of the White Mountains as well as on the plateau at the head of Owens Valley; and Mr. Stephens reported it common at Queen mine, in the White Mountains, Nevada, July 11–16. Along the eastern slope of the Sierra, it was abundant at Menache Meadows, May 24–26; at Kearsarge Pass, June 18–23; at Bishop Creek, August 4–10; and from 2,450 meters (8,000 feet) altitude to timber line at the head of Owens River the latter part of July; at Big Meadows and Horse Corral Meadows it was seen August 8–13; in Big Cottonwood Meadows it was very common all summer; at Round Valley, 12 miles south of Mount Whitney, August 28; and along the route from Soda Springs or Kern River Lakes to Mineral King, early in September. Mr. Nelson found it numerous among piñons on Mount Piños the later part of October.

Record of specimens collected of Picicorvus columbianus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
63	♂	Sierra Nevada, Calif.	May 27, 1891	F. Stephens	Summit Meadows, near Olancha Peak.
421	♂	do	Aug. 28, 1891	A. K. Fisher	Big Cottonwood Meadows.
430	♀	do	Aug. 28, 1891	do	Round Valley.
		do	Sept. 4, 1891	do	Soda Springs, Kern River.

Cyanocephalus cyanocephalus. Piñon Jay.

The piñon jay is more or less common on all the desert ranges of southern California and Nevada which are high enough to support a growth of piñons (*Pinus monophylla*), and was found in a few places on the Sierra Nevada, though in limited numbers. Mr. Nelson found it breeding in the piñon belt in the Panamint, Inyo, White, and Grapevine mountains, and Mr. Stephens saw a flock of a hundred or more in the latter range toward the end of March.

The writer found it common in the Argus Range above Maturango Spring. The stomach and gullet of one shot at this place about the middle of May contained the kernels of the pine nut, which it evidently had picked up from the ground, as some of them had already sprouted. The species was common on the Coso Mountains the last half of May. Dr. Merriam saw it on Mount Magruder and Gold Mountain, Nevada, early in June; in the Juniper Mountains, near the boundary between Nevada and Utah, May 18–19, and in the juniper belt on the east slope of the Beaverdam Mountains, in Utah, May 11.

Mr. Palmer saw a single bird in the Charleston Mountains among the tree yuccas, February 14.

In the Sierra Nevada Mr. Nelson saw it at the head of Owens River, though it was not numerous, and Mr. Stephens observed it at Bishop Creek, August 4–10, and noted one individual at Benton, July 9–10.

Record of specimens collected of Cyanocephalus cyanocephalus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
201	♂	Argus Range, Calif.	May 6, 1891	A. K. Fisher.	Maturango Spring.
206	♂	do	May 8, 1891	do.	Do.
207	♂	do	do	do.	Do.
223	♀	do	May 12, 1891	do.	Do.
319	♂	Coso Mountains, Calif	May 23, 1891	do.	

Molothrus ater. Cowbird.

Dr. Merriam saw several cowbirds in the Lower Santa Clara Valley, Utah, May 11–15, and a few in Pahranagat Valley, Nevada, May 22–26. The writer shot an adult male at Furnace Creek, Death Valley, June 20, which was the only one seen there.

Xanthocephalus xanthocephalus. Yellow-headed Blackbird.

Yellow-headed blackbirds were seen sparingly at a number of localities. Mr. Bailey secured a specimen at Bennett Wells, in Death Valley, April 1, and an individual came and alighted on the wagon while the party was at Darwin, in the Coso Valley, May 5. Dr. Merriam saw a few about the spring at Yount's ranch in Pahrump Valley, Nevada, April 29, and a number in the valley of the lower Muddy, May 6. Others were seen by him in Meadow Creek Valley, Nevada, near Panaca, May 19, and the species was said to breed in Pahranagat Valley, though he did not see it there, May 22–26. In the Lower Santa Clara Valley, Utah, it was tolerably common about the junction of the Santa Clara with the Virgin, May 11–15. In Salt Wells Valley, Mr. Stephens saw a small flock at Raymond Well, and at Borax Flat the last of April and first of May. At Lone Pine, in Owens Valley, one was seen among a flock of redwings in December, 1890. A number were observed in June, and several small flocks among the tules and along the fence rows, August 22. The species was seen sparingly at Bakersfield, in the San Joaquin Valley, July 17–20.

Record of specimens collected of Xanthocephalus xanthocephalus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂ ad.	Death Valley, Calif.	Apr. 1, 1891	V. Bailey	Bennett Wells.
325	♂ ad.	Lone Pine, Calif	June 9, 1891	A. K. Fisher	

Agelaius phœniceus. Red-winged Blackbird.

The red-winged blackbird is probably resident in most if not all of the tule marshes in southern California and Nevada. A small flock of eight or ten individuals was seen at Furnace Creek, Death Valley, during the latter part of January; a single specimen was secured at Resting Springs, California, in February. In Nevada a large flock was found during March around the corral of Mr. George Watkins, at Ash Meadows, where the birds fed upon grain left by the stock. Mr. Nelson stated that several hundred of these birds came to roost each night in the tules growing near the main spring at Pahrump Ranch, February 12–28. Mr. Stephens found it common in Oasis Valley, March 15–19, and at Grapevine Spring, California, the first week in April. Dr. Merriam saw it at Yount's ranch, in Pahrump Valley, April 29, and at the Bend of the Colorado, May 4. He found it breeding abundantly in the valley of the Muddy, in eastern Nevada, May 6; in Meadow Creek Valley, near Panaca, May 19; in Pahranagat Valley, May 23 and 24; in Oasis Valley, June 1; along the Santa Clara and Virgin, near St. George, Utah, May 14, and saw a few at the west end of Antelope Valley, near Gorman Station, California, June 28.

At Hot Springs, in Panamint Valley, Calif., several were seen April 20–24. In Owens Valley, Mr. Stephens found the species not common at Little Owens Lake, May 6–11; at Olancha May 16–23; abundant at Alvord, June 26–28; common at Bishop, June 30; at Fish Slough, July 2–3; at Morans, July 4–7; at Benton, July 9–10, and a few at Haway Meadows, May 12–14; and on the meadow at Bishop Creek, August 4–10. Mr. Nelson observed it at the head of Owens River up to an altitude of 2,130 meters (7,000 feet) during the latter part of July, and found it abundant about the farms at Lone Pine, in Owens Valley, December, 1890, where the writer saw numbers which were breeding in the tule marshes, the following June. The same observer also found it common along the South Fork of the Kern River, California, July 3–11; and Bakersfield, in the San Joaquin Valley, July 17–20.

Mr. Bailey saw flocks of redwings at Monterey, September 28 to October 9. Mr. Nelson found this species common and associated with *A. gubernator* about Buena Vista Lake in the San Joaquin Valley; in the wet places near San Emigdio, and along the coast between San Simeon and Carpenteria.

Record of specimens collected of Agelaius phœniceus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
138	♂	Ash Meadows, Nev	Mar. 18, 1891	A. K. Fisher	
	♂ ad.	do	do	E. W. Nelson	
111	♂ ad.	Resting Springs, Calif	Feb. 14, 1891	A. K. Fisher	
303	♂	Owens Valley, Calif	June 6, 1891	do	Lone Pine.
217	♂	do	June 8, 1891	do	Do.
118	♂	do	June 26, 1891	F. Stephens	Alvord.
124	♀	do	June 28, 1891	do	Do.
	♀	Fresno, Calif	Sept. 25, 1891	V. Bailey	

Agelaius gubernator. Bicolored Blackbird.

A..nough this species was common, if not abundant, in some localities west of the Sierra Nevada, one specimen only was collected during the season, and this was shot by Mr. Stephens at Olancha, at the southern end of Owens Lake, California, June 11.

Mr. Nelson found a few in the Ojai Valley in December; found it common and associated with the common redwing on the border of Buena Vista Lake in the San Joaquin Valley, near San Luis Obispo, and along the route from San Simeon to Carpenteria, in November and December. Mr. Belding recorded it from the Yosemite Valley.

Sturnella magna neglecta. Western Meadowlark.

The meadowlark is a more or less common resident in most of the valleys in the desert region, as well as in those west of the Sierra Nevada. It was common and singing at San Bernardino, December 28–29, 1890, and was seen in Cajon Pass, January 1. In Death Valley it was not uncommon at Bennett Wells, near the old Eagle borax works, at Saratoga Springs, and at Furnace Creek, where it was common in the alfalfa fields the last of January. On the last trip to the valley Mr. Bailey and the writer found it not uncommon at Furnace Creek, June 19–21. The meadowlark was not uncommon at Resting Springs in the Amargosa Desert, the first half of February and April 27, and was common about the ranches at Ash Meadows and in Pahrump and Vegas valleys, Nevada, in March. In the same State Dr. Merriam found it common in the sage-covered plateau of Mount Magruder, June 5–8; and in Oasis Valley, where it was abundant and singing in great numbers in the early evening, June 1. He also found it abundant and musical in Pahranagat Valley, May 22–26; along the valleys of the Virgin and lower Muddy May 6–8, and at Ash Meadows, May 30. In Utah it was common in alfalfa fields along the Lower Santa Clara, near its junction with the Virgin, May 11–15; thence northerly to Mountain Meadows and the Escalante Desert, May 17; and one was seen on the western side of the Beaverdam Mountains, May 10.

In California Mr. Nelson observed a few pairs breeding on the tableland between Saline and Panamint valleys, at the base and among the piñons of the Inyo Mountains, and on the plateau at the head of Owens Valley, at the base of the White Mountains. In the Coso Valley and

Mountains it was rare, only a few individuals being seen in May. It was common all through Owens Valley and on the lower part of the eastern slope of the Sierra Nevada. It was common all along Kern River Valley, July 3–13; at Walker Basin, July 13–16; in Tehachapi Valley, June 25; at Old Fort Tejon the last of June; and at Bakersfield, in the San Joaquin Valley, July 17–20. Mr. Bailey found it in flocks consisting of several hundred individuals at Monterey, September 28 to October 9, and Mr. Nelson reported it as common in the San Joaquin Valley, October 5–27, and along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Sturnella magna neglecta.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
98	♂	Resting Springs, Calif.	Feb. 6, 1891	A. K. Fisher	
69	♀	Death Valley, Calif	Jan. 23, 1891	do	Furnace Creek.
84	♂	do	Jan. 28, 1891	do	Do.
	♂	do	June 19, 1891	V. Bailey	Do.
79	♂	Owens Lake, Calif	June 9, 1891	F. Stephens	

Icterus parisorum. Scott's Oriole.

Scott's oriole is one of a number of birds whose known range has been greatly extended by the observations of the different members of the expedition. It was first observed at the summit of Shepherd Cañon in the Argus Range, Calif., May 1. All along the western slope of this range and in Coso Valley it was common, and males were in full song. On May 5 a female was secured, which contained an egg in the oviduct, and on May 7 a nest containing two eggs was found. It was placed on the lower side of a branch of a tree yucca about 8 feet from the ground, and was firmly attached to the bayonet-shaped leaves of the tree by threads of plant fiber and tough grasses. A number of old nests were seen in many places through the valley. In the Coso Mountains it was also common up to the summit among the yuccas, junipers, and piñons, where, on May 27, a nest containing an egg and three young was found in a yucca in Mill Cañon.

Mr. Nelson found it breeding in the Inyo, Panamint, and Grapevine mountains in the piñon belt. On the eastern slope of the Inyo Mountains, near Cerro Gordo, one was noted on June 15. On both slopes of the Panamint Mountains, near Cottonwood Cañon, he found it ranging from the yucca belt up to the summit of the divide, and in the Grapevine Mountains found it among the piñons. Everywhere he found it in pairs, the males singing from the tops of piñons. Above the 'charcoal kilns' in Wild Rose Cañon in the Panamint Mountains, Mr. Bailey and the writer saw the species and heard the males singing, June 24–25. Mr. Stephens heard it near the Queen mine in the White Mountains, Nevada, July 11–16. In the same State Dr. Merriam secured specimens in the Charleston Mountains April 30, and in the Juniper

Mountains, east of Panaca, May 19, when several pairs were seen mating. On Mount Magruder, Nevada, he found it tolerably common among the nut pines, where the birds seemed to be hunting for nesting sites, and were very difficult to approach. Several fine specimens were taken there June 4–11. The same observer found the species in the juniper belt of the Beaverdam Mountains, in Utah, May 10–11. In Walker Pass, on the east slope of the Sierra Nevada, several were seen and one shot among the yuccas June 21, and another on the western slope of the same pass in a *Pinus sabiniana* July 2.

Record of specimens collected of Icterus parisorum.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
196	♀	Argus Range, Calif.	May 5, 1891	A. K. Fisher	Maturango Spring.
	♂	do	May 9, 1891	T. S. Palmer	Do.
	♂	do	May 11, 1891	do	Do.
245	♂	Coso Mountains, Calif	May 21, 1891	A. K. Fisher	
251	♂	do	May 27, 1891	do	
	♂	Panamint Mountains, Calif.	May 8, 1891	E. W. Nelson	
	♂	do	May 12, 1891	do	
	im	Walker Pass, Calif	June 21, 1891	C. Hart Merriam	
	♀	Charleston Mountains, Nev.	Apr. 30, 1891	do	
	♀	Mount Magruder, Nev	June 4, 1891	do	
	♂	do	do	do	
	♂	do	June 8, 1891	do	

Icterus bullocki. Bullock's Oriole.

Bullock's oriole was tolerably common in several localities, where streams large enough to nourish a more or less extensive growth of trees were found. In Owens Valley it was common at Lone Pine, where a number of nests were observed in the willows, and several specimens secured, June 4–15. In the same valley, Mr. Stephens saw a solitary male at Little Owens Lake the first week in May; at Haway Meadows May 12–14; found the species rather common at Olancha May 16–23; common and a nest containing young at the mouth of the cañon at Independence Creek June 19; not common at Bishop, Fish Slough, and Morans July 1–7; and Benton July 9–10. Dr. Merriam saw one among the cottonwoods at Furnace Creek in Death Valley about the middle of April; in the Amargosa Cañon, and at Resting Springs, April 27. In Nevada, he saw it at Vegas Ranch, May 1; in the Valley of the Virgin and lower Muddy, May 6–8, and in Meadow Creek Valley, near Panaca, May 19. He found it tolerably common also in the Lower Santa Clara Valley, Utah, where it was breeding, May 11–15. On the western slope of the Sierra Nevada it was seen in Walker Pass, July 2; was common along the valley of the Kern June 22–23 and July 3–10; at Walker Basin July 13–16; and at Bakersfield July 17–20. It was common at Old Fort Tejon, and was seen in other parts of the Cañada de las Uvas in June and July. Mr. Nelson saw it in the Yosemite Valley, and Mr. Bailey, along the Kaweah River, in August.

Record of specimens collected of Icterus bullocki.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Death Valley, Calif.	April 7, 1891	V. Bailey	
297	♂	Owens Valley, Calif.	June 5, 1891	A. K. Fisher	Lone Pine.
298	♂	do	do	do	Do.
309	♂	do	June 7, 1891	do	Do.
322	♂ ad	do	June 9, 1891	do	Do.
323	♂ "	do	do	do	Do.
324	♀ "	do	do	do	Do.
87	♀	do	June 12, 1891	F. Stephens	Owens Lake.
	♀	Walker Pass, Calif.	July 3, 1891	V. Bailey	

Scolecophagus cyanocephalus. Brewer's Blackbird.

Brewer's blackbird was not a common species in many localities visited by the expedition, either in the desert region or among the mountains. At San Bernardino a number of flocks were seen, together with redwings, December 29, 1890. A few individuals were found about the ranch at Furnace Creek, in Death Valley, in the latter part of January, and at Resting Springs, in the Amargosa Desert, early in February.

In Nevada a few were seen at Ash Meadows and in Pahrump and Vegas valleys, where they kept about inclosures and out-houses, in March. Dr. Merriam found it in the same valleys April 29–30; at the Bend of the Colorado May 4; at Bunkerville in the Virgin Valley, May 8; in Meadow Creek Valley near Panaca, May 19; and in Pahranagat Valley May 22. A few were seen at Hot Springs, in Panamint Valley, April 20–25; in Saline Valley the latter part of June, and on the plateau at the foot of the White Mountains in July. In Owens Valley it was common at Olancha June 29; at Alvord June 26–28; at Morans July 4–7; at Benton July 9–10; rather common at Bishop Creek August 4–10; and a few were seen at Little Owens Lake May 6–11; at Haway Meadows May 12–14; and at Ash Creek May 30 to June 3.

In the High Sierra it was common at Menache Meadows May 24–26; at the head of Owens River the latter part of July; at Whitney Meadows, where Mr. Nelson saw a flock of twenty or more sitting on the backs of sheep, August 30. A dozen or fifteen were seen at Trout Meadows September 7, and it was found breeding at Big Cottonwood Meadows during the summer. It was common in Walker Pass July 2; along the valley of the Kern July 3–13; at Walker Basin, where it was feeding on grasshoppers, July 13–16; and at Bakersfield, in the San Joaquin Valley, July 17–20. Dr. Merriam saw many catching grasshoppers in Antelope Valley, at the west end of the Mohave Desert, June 27; found the species common in the Cañada de las Uvas June 27–28; and saw a few in the San Marcos Valley, San Diego County, July 1–10.

Mr. Bailey found it common at Monterey September 28 to October 9; and Mr. Nelson saw flocks in San Joaquin Valley, and found it generally distributed along the route from San Simeon to Carpenteria, in November and December.

Record of specimens collected of Scolecophagus cyanocephalus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
77	♀	Death Valley, Calif	Jan. 25, 1891	A. K. Fisher	Furnace Creek.
82	♀	do	Jan. 27, 1891	do	Do.

Coccothraustes vespertinus montanus. Western Evening Grosbeak.

The evening grosbeak was seen but once by the expedition. Mr. Bailey saw a small flock at Auburn, Calif., and secured two specimens October 22.

Record of specimens collected of Coccothraustes vespertinus montanus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Auburn, Placer Co., Calif	Oct. 22, 1891	V. Bailey	
	♀	do	do	do	

Pinicola enucleator. Pine Grosbeak.

Mr. Nelson saw a fine adult male pine grosbeak in brilliant plumage on the head of the San Joaquin River July 30. This individual was the only one seen during the year.

Carpodacus purpureus californicus. California Purple Finch.

Not obtained by any member of the expedition. Mr. Henshaw secured a single specimen near Mount Whitney, Calif., October 10, 1875.

Carpodacus cassini. Cassin's Purple Finch.

Cassin's purple finch was seen only in the higher parts of the White and Inyo mountains, and in the Sierra Nevada. Mr. Nelson saw two pairs in the *Pinus flexilis* belt on Waucoba Peak, in the Inyo Mountains, during the latter part of June, and secured two specimens at about 2,650 meters (8,700 feet) altitude in the White Mountains July 7. The same observer found it very abundant on the eastern slope, from 2,500 to 2,900 meters (8,200 to 9,500 feet) at the head of Owens River, and also at the head of the San Joaquin River, on the western slope.

It was also observed or secured at the following places in the High Sierra: at Horse Corral Meadows, August 11; at Cottonwood Meadows during the summer and as late as September 1; at Round Valley, which is 12 miles south of Mount Whitney, August 26–28; at Menache Meadows May 24–26; at Whitney Meadows the latter part of August, and near Mineral King during the latter part of August and early September.

Record of specimens collected of Carpodacus cassini.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂ im.	White Mountains, Calif	July 7, 1891	E. W. Nelson	
	♂	do	do	do	
137	♂	Sierra Nevada, Calif	July 22, 1891	F. Stephens	
	♂ im.	do	Aug. 11, 1891	T. S. Palmer	Horse Corral Meadows.
1	♂	do	June 19, 1891	B. H. Dutcher	Big Cottonwood Meadows.
7	♂	do	June 23, 1891	do	Do.
420	♀ im.	do	Aug. 21, 1891	A. K. Fisher	Do.
432	♂ im.	do	Aug. 30, 1891	do	Whitney Meadows.
	♂ im.	do	Aug. 1, 1891	V. Bailey	East Fork of Kaweah River, Calif.

Carpodacus mexicanus frontalis. House Finch.

The house finch was found wherever water was present in all localities visited by the expedition, except in the higher mountains among the pines, and undoubtedly bred wherever found. There was no other species of bird, with the possible exception of the dove, whose presence was so indicative of the nearness of water as the one under consideration. The writer never saw it more than a few hundred yards from water, except when flying high overhead.

After leaving Daggett on the Mohave Desert, Calif., house finches were seen at all the springs or water holes on the road to Death Valley. At Granite Wells flocks were found about the water at all times of day. In Death Valley a few were seen at Bennett Wells and between that place and Furnace Creek during the latter part of January. Dr. Merriam saw it at the latter place about the middle of April, and Mr. Bailey and the writer found it at both places on their last trip to the valley, June 19–22.

In the Panamint Mountains it was abundant in Johnson, Surprise, and Emigrant cañons, in April; at Willow Creek and Cottonwood Creek, in May; and in Wild Rose and Death Valley cañons, in June. In the Argus Range, the species was very abundant in Shepherd Cañon and at Maturango Spring, where it bred commonly, as it did in the Panamint Mountains.

As many as a dozen nests were found from April 25 to May 1, in various situations. A few were placed in crevices in the rocky sides of the cañon, while the majority were in bushes on the sloping hillsides, from one to several feet above the ground. The nests among the rocks were more compact, as they contained a larger amount of lining than those in the bushes, which in many cases were very loosely put together. The full complement of eggs in the different nests was four, five, and six. The species was common in the Coso, Inyo, and White mountains. It was everywhere common in Owens Valley from the lower to the upper part. In this valley, both at Independence and Lone Pine, the species was found to be very destructive to the ripened peaches during the middle of August. Flocks of birds occurred in the orchards, and in some places hardly an example of the ripe fruit could be found which was not more or less mutilated. A number of birds shot in the peach orchards at Lone Pine had little except the pulp of this fruit in their gullets or stomachs. It was known as the 'peach bird.'

It was common all along the route from Walker Pass, through the valley of Kern River, Walker Basin and Bakersfield to Visalia, June 21–23, and July 1 to 23, and at Old Fort Tejon late in June and early in July. It was seen at Ash Meadows and Pahrump Valley, Nevada, in March. In the same State, Dr. Merriam noted it among the cottonwoods at Yount's ranch in Pahrump Valley, April 29; at Mountain Spring, in the Charleston Mountains, and at Upper Cottonwood Springs near the east base of these mountains, April 30; near the summit of the Timpahute Mountains in tree yuccas, May 26; at Quartz Spring, on the west side of the Desert Mountains, May 27; at the Bend of the Colorado, May 4, and on Gold Mountain where a young one just able to fly was caught June 3, at an altitude of about 1,980 meters (6,500 feet). It was common in Tule Cañon June 4, and thence up to the plateau on top of Mount Magruder. In Arizona, he found it common at the mouth of Beaverdam Creek, May 9–10; in Utah, in the juniper belt of the Beaverdam Mountains, May 10–11, and at St. George, in the Lower Santa Clara Valley, May 11–15, where it was called 'peach bird' by the Mormons. Two nests were found at St. George, one in a cottonwood and the other in an arborescent cactus.

Mr. Nelson found the species in small numbers in the Cañada de las Uvas, at San Emigdio Creek, and in the Temploa Mountains, and rather common about the ranches in the San Joaquin Valley in October. It was common along the route from San Simeon to Carpenteria, among the farms along the coast, and not uncommon between the latter place and Santa Paula in November and December.

Record of specimens collected of Carpodacus mexicanus frontalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
45	♂	Daggett, Calif	Jan. 9, 1891	A. K. Fisher	
13	♂	do	Feb. 8, 1891	F. Stephens	
	♂	Panamint Mountains, Calif	Mch. 28, 1891	E. W. Nelson	Johnson Cañon.
158	♂	do	Apr. 13, 1891	A. K. Fisher	Surprise Cañon.
159	♀	do	do	do	Do.
187	♀	Argus Range, Calif	Apr. 27, 1891	do	Nest and eggs.
231	♂	do	May 12, 1891	do	Maturango Spring.
232	♂	do	do	do	Do.
*	♂	do	do	T. S. Palmer	Do.
	♂	do	do	do	Do.
349	♀	Death Valley, Calif	June 21, 1891	A. K. Fisher	Furnace Creek.

Loxia curvirostra stricklandi. Mexican Crossbill.

Crossbills were uncommon and seen only in the Sierra Nevada. At Big Cottonwood Meadows Dr. Merriam saw them just below timber line June 18, and towards the end of the season Mr. Dutcher saw a few and shot a pair. Mr. Nelson saw some on the west slope opposite the head of Owens River in August. At Horse Corral Meadows a noisy flock passed our camp August 12. Mr. Bailey saw the species at Whitney Meadows, and it was heard at Soda Springs or Kern River Lakes, September 5.

Record of specimens collected of Loxia curvirostra stricklandi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Sierra Nevada, Calif	Aug. 20, 1891	V. Bailey	Whitney Meadows.
	♂	do	Aug. 28, 1891	do	Do.
34		do	Aug. 22, 1891	B. H. Dutcher	Big Cottonwood Meadows.

Leucosticte tephrocotis. Gray-crowned Leucosticte.

A very interesting discovery made by the expedition was that the gray-crowned finch is a common summer resident in the higher portions of the White Mountains and the Sierra Nevada in eastern and southern California. The knowledge that this bird breeds as stated, makes its distribution in relation to the other species of the genus a little more clear.

In the Rocky Mountain region *Leucosticte atrata* is the northern and *L. australis* the southern representative, just as *Leucosticte t. littoralis* is the northern race of *L. tephrocotis* of the more western range.

Mr. Nelson found the gray-crowned finch breeding abundantly on the White Mountains, the only range except the Sierra Nevada on which the species was seen. It was found above timber line about the bases of the main peaks at an elevation from 3,350 to 3,650 meters (11,000 to 12,000 feet). He found the birds easy of approach as they were feeding on seeds and insects about the border of the melting snowdrifts.

The warm west wind coming from over Owens Valley brought many insects which became benumbed by the cold and fell on the snowdrifts. These the birds devoured eagerly, and Mr. Nelson saw them pursue and tear to pieces several grasshoppers on the surface of the snow. The condition of the skin on the abdomen showed that they were incubating and that both sexes shared in this labor. He noticed when skinning the birds that they had a double craw. One located in the usual place and the other in the form of a double gular sac divided by a median constriction. The latter when full hangs down like a lobe of bare skin outside of the feathers.

In the Sierra Nevada the same observer saw the species about timber line at the head of Owens River on the eastern slope, and at the same altitude on Kern, Kings, and Kaweah rivers on the western slope. Mr. Stephens found it abundant about the lakes at the head of Independence Creek, where it was breeding June 18–23, and also saw three above timber line at Menache Meadows, May 24–26. Mr. Dutcher saw several flocks and secured a few specimens at and above timber line at

Big Cottonwood Meadows, during the summer. Mr. Bailey found it common all along timber line and down among the *Pinus balfouriana* at Whitney Meadows. The writer did not see the species until August 18, when a flock of forty or more was seen on the west side of the Kearsarge Pass. Later in the day, during a snow storm, a flock was seen just below timber line on the east side of the Pass, and five specimens secured. The bad weather seemed to make them restless and hard to approach. At Round Valley, 12 miles south of Mount Whitney, the species was again seen just above timber line, August 28, and on the ridge north of Mineral King large flocks were seen September 8–11.

Record of specimens collected of Leucosticte tephrocotis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	White Mountains, Calif	July 15, 1891	E. W. Nelson	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♂	do	do	do	
	♀	do	do	do	
	♀	do	do	do	
	♀	do	do	do	
	♀	do	do	do	
	♀	do	do	do	
	♀	do	do	do	
	♀	Sierra Nevada, Calif	July 25, 1891	E. W. Nelson	Summit of Mammoth Pass, Cal.
417	♂	do	Aug. 18, 1891	A. K. Fisher	Kearsarge Pass, 11,000 feet altitude.
418	♀ im	do	do	do	Do.
419	♀ im	do	do	do	Do.
112	♂	do	June 22, 1891	F. Stephens	Independence Creek, 10,000 feet.
113	♀	do	do	do	Do.
114	♀	do	do	do	Do.
115	♂	do	do	do	Do.
79	im	do	July 30, 1891	B. H. Dutcher	Big Cottonwood Meadows.
[illegible]	♂	do	Aug. 2, 1891	do	Do.
	♀ im	do	Aug. 20, 1891	V. Bailey	Do.
[illegible]	♂ im	do	Aug. 28, 1891	A. K. Fisher	Round Valley, above timber line.
161	♀ im	do	Aug. 23, 1891	F. Stephens	Olancha Peak, 12,000 feet altitude.
	♂	do	Aug. 7, 1891	V. Bailey	Mineral King, 9,700 feet altitude.

Leucosticte atrata. Black Leucosticte.

Mr. Bailey secured one specimen of this species at St. George, Utah, January 21, 1889. It was feeding alone on a rocky hill, among low brush.

Spinus tristis. Goldfinch.

A common species throughout southern California, though not recorded by any member of the expedition.

Spinus psaltria. Arkansas Goldfinch.

The Arkansas goldfinch was observed in a number of localities throughout the mountain and desert regions visited. At San Bernardino a flock of eight or ten was seen feeding on the seeds of a wild sunflower, December 28, 1890. Small flocks were seen in Cajon Pass, January 2, again March 29–30, and in the cottonwoods bordering the Mohave River near Victor, March 30.

In Nevada, it was not uncommon at Ash Meadows in March; at Queen station and mill in the White Mountains, July 11–16. Dr. Merriam found it at Upper Cottonwood Springs at the east base of the Charleston Mountains, April 30; at the Bend of the Colorado River, May 4; and in Pahranagat Valley, where it was breeding commonly, May 23. At the mouth of Beaverdam Creek, Arizona, and on the west side of the Beaverdam Mountains, Utah, he saw several May 9–10. As no specimens were taken for identification, the Arizona and Utah records may apply to *Spinus psaltria arizonæ*.

In the Panimint Mountains it was common in Johnson and Surprise cañons, and in the latter place Mr. Albert Koebele found a nest, just completed, April 23. In the same mountains Mr. Nelson found it a common breeding species in Cottonwood, Mill Creek, and Willow Creek cañons. In the Argus Range it was common in Shepherd Cañon, where a nest and four eggs were taken April 27, and at Maturango Spring the first half of May. At Coso Mountains a few were seen along the streams in the cañons, the last of May.

Mr. Nelson found it common in the Grapevine Mountains, and rather common in the Inyo Mountains, in willow patches along the streams up to the piñons, the latter part of June. Goldfinches were common at the head of Owens River, abundant in the Yosemite, and from the base up to the nut-pines in the White Mountains. The were more or less common in Owens Valley from the lower end, at Little Owens Lake, northward to Benton and the foot of the White Mountains. A few were seen in Walker Pass, July 2–3; the species was common along the South Fork of Kern River, July 3–10; in Walker Basin, July 13–16; and at Bakersfield, in the San Joaquin Valley, July 17–20. In the High Sierra Dr. Merriam saw the species near Big Cottonwood Meadows, June 18, and the writer observed a flock near the abandoned sawmill in Sequoia National Park, August 1.

Mr. Palmer reported it common at Old Fort Tejon during the first half of July; Mr. Stephens found it rather common at Reche Cañon September 22–24, and Mr. Bailey saw it in flocks at Monterey September 28 to October 9.

It was common at Three Rivers July 25–30, and along the route from Mineral King to that place September 12–15.

Mr. Nelson found it common and generally distributed between San Simeon and Carpenteria and Santa Paula, in November and December.

Record of specimens collected of Spinus psaltria.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
7	♂	San Bernardino, Calif	Dec. 28, 1890	A. K. Fisher	
189	♀	Argus Range, Calif	April 27, 1891	....do	Shepherd Cañon, nest and 4 eggs.
191	♂	......do	April 29, 1891	....do	Shepherd Cañon.
217	♂	......do	May 12, 1891	....do	Maturango Spring.
268	♂	Walker Pass, Calif	July 3, 1891	....do	
271	♂	Kern River, Calif	July 4, 1891	....do	South Fork.
	♂	Pahranagat Valley, Nevada	May 23, 1891	C. Hart Merriam	
	♂	Santa Clara, Utah	May 11, 1891	V. Bailey	

Spinus psaltria arizonæ Arizona Goldfinch.

This subspecies was found breeding in great abundance in the Lower Santa Clara Valley, Utah, by Dr. Merriam. Five nests with fresh eggs were found, and one with eggs nearly ready to hatch, May 11–15. In California Mr. Bailey secured a specimen from a flock at Three Rivers, in the western foothills of the Sierra Nevada, September 15.

Spinus lawrencei. Lawrence's Goldfinch.

Dr. Merriam reported Lawrence's goldfinch as common in the Cañada de las Uvas, June 28–29, and in the Granite Range in western San Diego County, July 1–10. Mr. Palmer saw a male near Old Fort Tejon, June 30, and shot one in the cañon July 6. A specimen was secured in Walker Basin July 16, and an individual was seen among the oaks above it, July 14. These are all the records we have for the species.

Spinus pinus. Pine Siskin.

At two places only was this species seen by members of the expedition, both in the High Sierra in California. Mr. Nelson saw it at the head of the San Joaquin River, in August, and the writer observed a flock of a dozen or fifteen near timber line above Mineral King, September 10. The birds were feeding upon seeds on or near the ground, and when flushed alighted on a pine branch within a few feet of the observer.

Poocætes gramineus confinis. Western Vesper Sparrow.

The vesper sparrow was seen in comparatively few places on either side of the Sierra Nevada. At Ash Meadows, Nevada, it was not uncommon in migration March 10, and a few were seen by Mr. Bailey at Vegas Ranch, March 10–13.

Mr. Nelson found a few among the sage brush above the piñons in the Inyo Mountains, in June; not uncommon on the White Mountains, and on the plateau at the head of Owens Valley, in July; and common at the head of Owens River, in the same month. Dr. Merriam found the species at Mountain Meadows, Utah, May 17. A single specimen was seen near Visalia, Calif., September 17, a few near the lower end of the Cañada de las Uvas and San Emigdio Cañon, and on the Carrizo Plain, in San Joaquin Valley, in October.

Ammodramus sandwichensis alaudinus. Western Savanna Sparrow.

This little sparrow was found nowhere common, though it breeds sparingly in various localities throughout the desert regions. The writer found it not uncommon in the alfalfa fields at Furnace Creek, Death Valley, in the latter part of January, and Dr. Merriam found a few at the same place April 9–12, but Mr. Bailey and the former observer did not detect it on their last trip to the valley, June 19–22. Mr. Nelson found a few at Saratoga Springs, in the lower end of the valley, late in January. A few were seen at Resting Spring, California early in February; a number of specimens were secured in the wet meadows at Ash Meadows, Nevada, during the first three weeks of March; and Mr. Nelson found it not uncommon about wet ground in Pahrump and Vegas valleys and in Vegas Wash March 3–16. Dr. Merriam shot one at the Great Bend of the Colorado May 4; one in Meadow Creek Valley, Nevada, May 19, and a number in Pahranagat Valley, Nevada, May 22–26.

In Owens Valley the writer found it not uncommon and breeding among the salt grass at Owens Lake May 30 to June 4, and at Lone Pine June 4–15; and Mr. Stephens found it not uncommon at Olancha, May 16–23; Alvord, June 26–28; and Morans, July 4–7.

A pair was seen by Mr. Nelson at the head of Owens Valley near the White Mountains about the middle of July, and by the writer at Three Rivers, in the western foothills, September 16. It was common along the coast from San Simeon to Santa Barbara, and a few were seen near Carpenteria in December.

Record of specimens collected of Ammodramus sandwichensis alaudinus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Great Bend of Colorado River, Nev	May 4, 1891	C. Hart Merriam	
	♂	Pahrump Valley, Nev	Feb. 17, 1891	E. W. Nelson	
	♂	Ash Meadows, Nev	Mar. 4, 1891	do	
	♀	do	do	do	
119	♀	do	Mar. 8, 1881	A. K. Fisher	
120	♀	do	Mar. 9, 1891	do	
129	♀	do	Mar. 15, 1891	do	
	♂	do	Mar. 19, 1891	E. W. Nelson	
106	♂	Resting Springs, Calif	Feb. 11, 1891	A. K. Fisher	
	♀	Death Valley, Calif	Jan. 31, 1891	E. W. Nelson	Saratoga Spring.
79	♀	do	Jan. 26, 1891	A. K. Fisher	Furnace Creek.
91	♂	do	Jan. 31, 1891	do	Do.
92	♂	do	do	do	Do.
179	♀	Panamint Valley, Calif	Apr. 23, 1891	do	Hot Springs.
283	♀	Owens Valley, Calif	June 2, 1891	do	Keeler.
291	♂	do	June 3, 1891	do	Do.
61	♂	do	May 22, 1891	F. Stephens	Olancha.
88	♂	do	June 12, 1891	do	Do.
103	♀	do	June 15, 1891	do	Do.
292	♂	do	June 5, 1891	A. K. Fisher	Lone Pine.
	♀	Fresno, Calif	Sept. 25, 1891	E. W. Nelson	

Ammodramus sandwichensis bryanti. Bryant's Marsh Sparrow.

Mr. Nelson found Bryant's sparrow common along the coast from Santa Barbara to Carpenteria during the first half of December.

Record of specimen collected of Ammodramus sandwichensis bryanti.

Collectors No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Carpenteria, Calif	Dec. 18, 1891	E. W. Nelson	
	♂	do	do	do	
	♀	do	do	do	

Chondestes grammacus strigatus. Western Lark Sparrow.

The western lark sparrow is a characteristic inhabitant of the Upper Sonoran and Transition Zones and was not found in the Lower Sonoran Zone, except west of the Sierra Nevada, and during migration. It was a common species in Owen's Valley from the lower end northward, and was breeding wherever found. The writer found it abundant along the South Fork of Kern River, at Kernville, and in Walker Basin during the first half of July. In the San Joaquin Valley it was abundant at Bakersfield, and all along the route to Visalia, July 17–23, and at Three Rivers, July 25–30 and September 14–17.

Dr. Merriam furnished the following notes on the species: "In Nevada it was common throughout the sage brush on the rolling plateau that forms the northward continuation of the Juniper Mountains, May 18, and in Desert and Pahranagat valleys, May 20–26. In Pahranagat Valley it was particularly abundant, breeding and in full song. It was common in the north part of Oasis Valley, June 1, but was not observed at the southern end of this valley. On Mount Magruder a few were seen in the sage brush June 5. Others were found at Mountain Spring in the Charleston Mountains and at Upper Cottonwood Springs at the east base of these mountains, April 30; and in the Valley of the Muddy, May 6. Several were seen in the lower edge of the junipers on both sides of the Beaverdam Mountains in southwestern Utah, May 10 and 11. It was found also in the Santa Clara Valley, Utah, May 11–15, and was common in Mountain Meadows, Utah, May 17. In Owens Valley, California, it was common in the sage brush of the Upper Sonoran Zone, June 10–19, and in Antelope Valley at the west end of the Mohave Desert, June 27–28. On the west slope of the Sierra Nevada it was abundant in the valley of Kern River, where full-grown young were conspicuous, June 22–23. It was seen in the Tehachapi Valley, June 25, and in the Cañada de las Uvas, June 28–29, where full-grown young were common."

Mr. Nelson found it rather common in the Cañada de las Uvas and San Emigdio Cañon, at various places in San Joaquin Valley and about the borders of the foothills, in October, and in the more open country along the route from San Simeon to Carpenteria, in November and part of December.

Record of specimens collected of Chondestes grammacus strigatus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
307	♀	Owens Valley, Calif.	June 6, 1891	A. K. Fisher	Lone Pine.
308	♂	......do	....do	......do	Do.
320	♀	......do	June 9, 1891	......do	Do.

Zonotrichia leucophrys. White-crowned Sparrow.

The white-crowned sparrow was a common summer resident in the Sierra Nevada and White Mountains, but was not found in any other locality, even as a migrant—at least specimens were not taken elsewhere. There is uncertainty as to the race which breeds among the piñons in the Inyo Mountains, as no specimens were collected there. Mr. Nelson found the white-crowned sparrow on the plateau at the head of Owens Valley, and thence up to near timber line in the White Mountains, and Mr. Stephens saw it at the Queen mill and mine, Nevada, in the same range, July 11–16. Along the eastern slope of the Sierra it was common at the head of Owens River, the last of July; rather common at Menache Meadows, May 24–26; Onion Lake on Independence Creek, June 18–23; and at Bishop Creek, August 4–10. Mr. Dutcher found it very common among the willows at Big Cottonwood Meadows, where nests were taken. Mr. Palmer saw a nest containing three eggs near Mount Silliman, August 7, and Mr. Belding found the species in the Yosemite. White-crowned sparrows were common in flocks at Whitney Meadows, September 1, Farewell Gap, September 8, and from timber line above Mineral King down along the Kaweah River to below the pines, September 10–12.

Record of specimens collected of Zonotrichia leucophrys.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
148	im	Sierra Nevada, California	Aug. 8, 1891	F. Stephens	Bishop Creek.
116	♂	......do	June 22, 1891	....do	Independence Creek.
	♀	......do	July 31, 1891	V. Bailey	Mineral King.
	♂	White Mountains	July 10, 1891	E. W. Nelson	
162	♂	Sierra Nevada	Aug. 26, 1891	F. Stephens	Mulkey Meadows.
	♀	......do	July 7, 1891	B. H. Dutcher	Big Cottonwood Meadows.
	♀	......do	July 13, 1891	....do	Do.
	♂	......do	July 19, 1891	....do	Do.
422	♂ im	......do	Aug. 25, 1891	A. K. Fisher	Do.

Zonotrichia leucophrys intermedia. Intermediate Sparrow.

The intermediate sparrow was found as a migrant or winter resident only, through the desert regions, where it was often abundant among the mesquite or other thickets. In Cajon Pass it was very common January 1–2, and again March 30. In the Mohave Desert it was common at Hesperia January 4, and about Stoddard Wells January 6. In Death Valley it was common about Furnace Creek ranch the last of

January and April 9-12, and at Resting Springs the first half of February and April 27. At the latter place the flocks became very tame and came into camp to pick up the crumbs.

It was common about the ranch and among the mesquite at Ash Meadows, Nev., during the greater part of March, and Mr. Nelson found it abundant at Pahrump and Vegas ranches and among the junipers in the Charleston Mountains during the same month. Dr. Merriam found it common at Leach Point Spring, Calif., April 25; at Mountain Spring in the Charleston Mountains, Nev., April 30; in the Valley of the Virgin near Bunkerville, May 8, and a few tardy migrants in Pahranagat Valley May 22–26. In the Santa Clara Valley, Utah, the subspecies was still tolerably common May 11–15. In the Panamint Mountains it was common in Johnson, Surprise, and Emigrant cañons in April, and Mr. Nelson found a few late migrants on Willow Creek the last of May. The sparrow was abundant among the mesquite at Hot Springs, Panamint Valley, April 20–25; a few were seen at Searl's garden, near the south end of the Argus Range, about the same time, and a few in Shepherd Cañon as late as May 1. In the latter place Mr. Nelson reported it very common in January. Mr. Stephens found it rather common in the lower end of Oasis Valley, Nev., March 15–19, and at Grapevine Spring, Calif., April 1–4.

A few were observed by Mr. Nelson about the Cañada de las Uvas and San Emigdio Cañon in October, and along the coast from San Simeon to Carpenteria in November and December.

Record of specimens collected of Zonotrichia leucophrys intermedia.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
28	♀ im.	Cajon Pass, Calif	Jan. 2, 1891	A. K. Fisher	
25	♀	do	do	do	
29	♂	Hesperia, Calif	Jan. 4, 1891	do	
6	♂	Daggett, Calif	Feb. 7, 1891	F. Stephens	
69	♀	Death Valley, Calif	Jan. 23, 1891	A. K. Fisher	Furnace Creek.
67	♂	do	do	do	Do.
81	♂ im.	do	Jan. 27, 1891	do	Do.
106	♀	Resting Springs, Calif	Feb. 10, 1891	do	
123	♂	Ash Meadows, Calif	Mar. 11, 1891	do	
137	♀	do	Mar. 19, 1891	do	
	♀	Panamint Mountains, Calif	Mar. 29, 1891	E. W. Nelson	Johnson Cañon.
	♂	do	do	do	Do.
	♂	do	do	do	Do.
	♂	Panamint Valley, Calif	Apr. 22, 1891	do	Hot Spring.
	♀	do	Apr. 23, 1891	do	Do.
	♀	do	do	do	Do.
	♂	do	Apr. 14, 1891	V. Bailey	Emigrant Spring.
28	♀	Argus Range, Calif	Apr. 22, 1891	F. Stephens	Borax Flat.
	♀	Carpenteria, Calif	Dec. 18, 1891	E. W. Nelson	

Zonotrichia leucophrys gambeli. Gambel's Sparrow.

Gambel's sparrow was not met with east of the Sierra Nevada, and on the western side as a migrant only. Mr. Bailey found it abundant at Monterey the first week in October, and Mr. Nelson reported it common in the San Joaquin Valley wherever a vigorous growth of bushes or weeds afforded attractive shelter. Along the route from

San Simeon to Carpenteria and Santa Paula it was abundant during November and December.

Zonotrichia coronata. Golden-crowned Sparrow.

The golden-crowned sparrow was found by Mr. Nelson to be abundant and generally distributed along the coast from San Simeon to Carpenteria and Santa Paula during November and December. This is the only region where the species was noted.

Zonotrichia albicollis. White-throated Sparrow.

Mr. Nelson secured a male specimen of the white-throated sparrow at the mission of Santa Ynez, December 6, 1891, which makes the fourth record for California.

Spizella monticola ochracea. Western Tree Sparrow.

The only place where the tree sparrow was seen was Pahrump ranch, Nevada, where Mr. Nelson found quite a number in the willow thickets, the latter part of February. They appeared quite suddenly one morning before a storm, which filled the valley with rain and covered the mountains with snow.

Spizella socialis arizonæ. Western Chipping Sparrow.

The chipping sparrow was not found to be a common migrant in the valleys, though it was more or less common as a summer resident in the mountains, from the piñons and junipers up to and among the other conifers. A number were seen in the cultivated fields about San Bernardino, December 28–29, 1890. Mr. Nelson saw a few on the Panamint Mountains the latter part of May and found the species breeding on the Grapevine Mountains, June 10–11. A few were seen about Maturango Spring, where the males were in full song, May 13–14. The species was found up to timber line in the White Mountains, and was common at the head of Owens River, in the Sierra Nevada. Dr. Merriam found it on the north slope of Telescope Peak in the Panamint Mountains, April 17–19; among the junipers in the Juniper Mountains, Nevada, May 18; and among the piñons on Mount Magruder, Nevada, June 5. In Walker Basin it was common among the pines above the valley, July 14, and Mr. Palmer found it quite common at Old Fort Tejon about the same time. In the High Sierra it was common in the Sequoia National Park the first week in August; at Horse Corral Meadows, August 9–13; in Big Cottonwood Meadows during the summer and fall; at Whitney Meadows, the first week in September; at Mineral King, near timber line, September 9–11; and along the Kaweah River, from Mineral King to the valley, September 11–13.

Record of specimens collected of Spizella sociailis arizonæ.

Collector's No.	Sex.	Locality.	Date.	Colletcor.	Remarks.
1	♂	San Bernandino, Calif	Dec. 28, 1890	A. K. Fisher	
158	♀	Sierra Nevada, Calif	Aug. 22, 1891	F. Stephens	Olancha Peak.
	♂ im.	do	Aug. 29, 1891	V. Bailey	Whitney Meadows.

Spizella breweri. Brewer's Sparrow.

Brewer's sparrow was a common species throughout the desert regions during migration, and bred in most of the mountain ranges among the sagebrush. A number were seen in Vegas Wash, March 10–13, and the species arrived at Ash Meadows, Nevada, March 17. Mr. Nelson reported it as a common breeding species among the sage, both in the Panamint and Grapevine mountains, during the latter part of May and first of June. Many of its nests were found, usually containing four eggs, and built in a sage bush a couple of feet from the ground. On the north side of Telescope Peak Dr. Merriam found it common among the sage, April 17–19, and Mr. Bailey and the writer observed it near the same place, June 22–25. It was not uncommon at Hot Springs, in Panamint Valley, April 20–23; several were seen at Leach Point Spring, April 25; and one was shot in the northwest arm of Death Valley, April 13.

In Nevada Dr. Merriam found it tolerably common in parts of Pahrump Valley, April 29, and at Mountain Spring, in the Charleston Mountains, April 30. He reported it as common in the sage brush on the plateau of the Juniper Mountains; in Pahranagat Valley, May 22–26; on Gold Mountain, June 3; in Tule Cañon, June 4; and thence up to the summit of Mount Magruder, where it was the commonest bird on the sage plateau, June 4–11, breeding abundantly, and extending thence northerly into Fish Lake Valley.

In Utah Dr. Merriam did not see it in the low St. George Valley, but found it common in the upper part of the Santa Clara Valley, May 16, beginning with the sagebrush about 8 miles north of St. George and continuing northward to Mountain Meadows and the Escalante Desert, where several nests were found, May 17. In the Beaverdam Mountains it was tolerably common throughout the sage and junipers, May 10.

Returning to California, in the Argus Range, the species was common in Shepherd Cañon, and was breeding commonly at Maturango Spring, from the summit of the range to the bottom of Coso Valley, early in May. In the Coso Mountains it was common, and a number of nests containing eggs were found during the latter part of May. Mr. Nelson found the species rather common in the Inyo Mountains, from the sage up to the summit in the White Mountains, and at the head of Owens River in the Sierra Nevada. In Owens Valley it was common throughout the summer, especially along the eastern slope of the Sierra Nevada, where Mr. Stephens noted it in a number of places, even as high as Menache Meadows. It was common on the western slope of Walker Pass, June 21 and July 2–3, and in Kern River Valley, June 22–23 and July 11–13. Mr. Palmer reported it as tolerably common in the sagebrush among the piñons at Old Fort Tejon, July 9.

Record of specimens collected of Spizella breweri.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
130	♂	Ash Meadows, Nev	Mar. 17, 1891	A. K. Fisher	
	♂	......do	Mar. 18, 1891	E. W. Nelson	
	♀	Panamint Valley, Calif.	Apr. 22, 1891	....do	Hot Springs.
46	♂	Panamint Mts., Calif.	Apr. 16, 1891	F. Stephens	
203	♂	Argus Range, Calif.	May 6, 1891	A. K. Fisher	Maturango Springs
213	♂	......do	May 8, 1891	....do	Do.
81	♀	Owens Lake, Calif.	June 10, 1891	F. Stephens	
105	♂ im	......do	June 15, 1891	....do	

Spizella atrigularis. Black-chinned Sparrow.

The black-chinned sparrow is one of a number of species whose known range was much extended by the observations of the expedition. It was first observed in Johnson Cañon in the Panamint Range, where an adult male was seen among the junipers, April 6. In Surprise Cañon, of the same range, the species was first seen April 15, when two specimens were secured, and subsequently it became common.

The song, which was frequently heard, resembles closely that of the Eastern field sparrow (*Spizella pusilla*). At Maturango Spring, in the Argus Range, a male was seen among the sage (*Artemisia tridentata*) on May 12, and a female was secured among the willows near the spring, which had an egg in the oviduct, almost ready for expulsion, May 15. In the Coso Mountains the species was not uncommon, and on May 27 a female with her nest and three eggs was secured. The nest was situated in a small bush about two feet from the ground, on a gradually sloping hillside bearing a scattered growth of piñon.

On the west side of Owens Valley Mr. Stephens heard several singing on Independence Creek, near the Rex Monte mill, and secured a specimen June 20. On the western slope of Walker Pass a specimen was secured in one of the cañons, as it was washing at a pool, July 3, and at Walker Basin an immature bird was shot on the ridge above the valley, July 14.

Record of specimen collected of Spizella atrigularis.

Collectors No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Mountains, Calif.	Apr. 16, 1891	E. W. Nelson	Surprise Cañon.
160	♂	......do	Apr. 15, 1891	A. K. Fisher	Do.
161	♀	......do	....do	....do	Do.
241	♀	Argus Range, Calif.	May 15, 1891	....do	Maturango Spring.
259	♀	Coso Mountains, Calif.	May 27, 1891	....do	Nest and eggs.
260	♂	......do	....do	....do	
360	♀	Walker Pass, Calif.	July 3, 1891	....do	
392	♂	Walker Basin, Calif.	July 14, 1891	....do	
109	♂	Independence Creek, Calif.	June 20, 1891	F. Stephens	Owens Valley.

Junco hyemalis. Slate-colored Junco.

A specimen of the common eastern junco was secured by the writer in Johnson Cañon in the Panamint Range, April 3, and another was seen a day or two later in the same locality. Mr. Bailey took one near Fort Mohave, Ariz., March 4, 1889.

Junco hyemalis shufeldti. Shufeldt's Junco.

A specimen collected in the Charleston Mountains and another in the Grapevine Mountains, Nevada, in March, belong to this race. Whether the species remains in these ranges to breed, or passes further east for that purpose, it is impossible to say, as no specimens were collected there later in the season.

Record of specimens collected of Junco hyemalis shufeldti.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Charleston Mountains, Nev	Mar. 7, 1891	V. Bailey	
25	♀	Grapevine Mountains, Nev	Mar. 21, 1891	F. Stephens	

Junco hyemalis thurberi. Thurber's Junco.

Thurber's junco was a common species in many places throughout the desert region of southeastern California, and bred commonly in most of the desert ranges, as well as in the Sierra Nevada. It was very common in Cajon Pass in the San Bernardino Mountains, January 2, and several were seen there March 30. Mr. Nelson found juncos common at Lone Pine, in the cañons at the foot of the Sierra Nevada, also in Surprise Cañon of the Panamint, and Shepherd Cañon of the Argus range, in December and early January. The individuals which he found in considerable numbers at Pahrump ranch, and in the Charleston Mountains, in February and March, may or may not have been wholly or in part referable to this form, as a single specimen collected in the Charleston Mountains belongs to the more eastern race, *shufeldti*. The same may be said of the few pairs of birds he found breeding near the summit of the Grapevine Mountains, in June, as no specimens were collected at that time. It was common in Johnson and Surprise cañons, in the Panamint range, during the first half of April; Dr. Merriam saw many on the north base of Telescope Peak, April 16–19, and Mr. Bailey and the writer saw it from the summit of that peak down to below the 'charcoal kilns', in Wild Rose Cañon, June 23. It was tolerably common among the piñons in the Argus range, where specimens were secured during the first half of May, and Mr. Palmer saw one in the Coso Mountains May 27, and others at Cerro Gordo, in the Inyo range, May 31. Mr. Nelson found it sparingly among the *Pinus flexilis* in the latter range the last of June, and not common in the White Mountains in July. Mr. Stephens found it not common from the Rex Monte mine to timber line in Independence Cañon, June 18–23; at Queen mine, White Mountains, Nevada, July 11–16; common at Bishop Creek, August 4–10, and Menache Meadows, May 24–26. Juncos were common on the ridge above Walker Basin, July 14, and Mr. Palmer saw three back of

Old Fort Tejon July 6, which had probably descended from the mountains where they were common among the pines July 9. Mr. Nelson reported this species as abundant at the head of Owens River, where he found a nest containing four eggs nearly ready to hatch, July 25. On the western slope it was also common. On the upper Merced he found two nests on August 3, one containing a young bird and three eggs nearly ready to hatch, and the other three fresh eggs. The first mentioned nest was nicely hidden under a projecting spruce root on the side of a small gully, and the latter was placed in a clump of aspens at the base of a small sapling, was strongly made, and was lined with the long hairs of the porcupine.

Juncos were very common in the Sequoia National Park during the first week of August. One nest with three eggs was found, and young as large as their parents were seen. They were common at Horse Corral Meadows August 9–13, Big Cottonwood Meadows and Round Valley the last of August, and at Whitney Meadows and Mineral King early in September. Mr. Dutcher found them abundant at Big Cottonwood Meadows where he discovered several nests, and Mr. Bailey observed them on the Kaweah River from the lowest conifers to above timber-line. A nest with young was found among the giant redwoods July 29.

Mr. Nelson reported the species as common on high ground along the route from San Simeon to Carpenteria in November and December; it was also common on the route from La Panza to San Luis Obispo October 28 to November 3; and a few were seen at Santa Paula the last of December.

Record of specimens collected of Junco hyemalis thurberi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint Mountains, Calif.	Mar. 28, 1891	E. W. Nelson	Johnson Cañon.
	♂	do	do	do	Do.
149	♂	do	Apr. 2, 1891	A. K. Fisher	Do.
170	♀	do	Apr. 19, 1891	do	Surprise Cañon.
	♂	do	do	E. W. Nelson	Do.
353	♂	do	June 23, 1891	A. K. Fisher	Coal kilns.
202	♂	Argus Range, Calif.	May 6, 1891	do	Maturango Spring.
	♂	do	May 9, 1891	T. S. Palmer	Do.
	♀	do	do	do	Do.
111	♀	Owens Valley, Calif.	June 21, 1891	F. Stephens	Independence Creek. Sitting.
133	♂	White Mountains, Calif	July 13, 1891	do	10,000 feet altitude.
	♂	do	July 14, 1891	E. W. Nelson	
22	♂	Cajon Pass, Calif	Jan. 2, 1891	A. K. Fisher	
	♀	Sierra Nevada, Calif.	Aug. 7, 1891	V. Bailey	Mineral King.
5	♂	do	June 19, 1891	B. H. Dutcher	Big Cottonwood Meadows.
	♀	do	July 7, 1891	do	Do.
37	♂	do	Sept. 14, 1891	do	Do.
38	?	do	do	do	Do.
414	♀ ad.	do	Aug. 12, 1891	A. K. Fisher	Horse Corral Meadows.
144	♂ im.	do	July 27, 1891	F. Stephens	
	♂	do	July 22, 1891	E. W. Nelson	
	♀	do	July 25, 1891	do	Nest and eggs.
	♂	San Emigdio Cañon, Calif.	Oct. 18, 1891	do	

Junco pinosus. Point Pinos Junco.

This species has been described by Mr. Leverett M. Loomis since the return of the expedition. Juncos which were seen at Monterey by Dr. Merriam and Mr. Bailey undoubtedly belong to this species.

Amphispiza bilineata. Black-throated Sparrow.

The black-throated desert sparrow is one of the most abundant and characteristic birds of the Lower Sonoran zone, in which it breeds abundantly. The writer first observed the species in the Funeral Mountains, at the summit of Furnace Creek Cañon, on March 22, while on the return trip to Death Valley from Ash Meadows, Nevada. The four or five males which were seen evidently had just arrived, as Mr. Bailey and Mr. Nelson, who had passed over the same route a few days before, saw none. The bird was common on both slopes of the Panamint Mountains, in Johnson and Surprise cañons, during the first three weeks of April, where it was in full song most of the time. It was common in the Argus range from the valley to the summit. In Coso Valley, below Maturango Spring, Mr. Palmer and the writer found several nests. On May 12 two were discovered, one containing three young and the other four eggs, and on May 13 a nest was found just completed. In the Coso Mountains this sparrow was common, and its nest was found in various kinds of bushes, though the branching cactus (*Opuntia echinocarpa*) seemed to be the most common site. A nest containing eggs was found near the road between Darwin and Keeler as late as May 30.

When Mr. Bailey and the writer returned to Death Valley in the latter part of June, they did not find this bird in the valley proper, but found it a few hundred feet above, in Death Valley Cañon, and all through the Panamint Mountains. The same observers found it common both on the east and west slope of Walker Pass, in the Sierra Nevada, on July 1–3, and the former saw several on the South Fork of the Kern River July 3–10.

Dr. Merriam furnishes the following notes on the species as observed by him on the trip to and from St. George, Utah: "In California it was common on the Mohave Desert, between the mouth of Cajon Pass and Pilot Knob, in the early part of April; and at the west end of the desert (Antelope Valley) June 27, and was found also near Lone Willow Spring, in Windy Gap, in Death Valley, in Emigrant Cañon, and in Leach Point Valley. In Owens Valley, California, it was common in the Lower Sonoran zone where it ranges north on the east side of the valley as far as Alvord, and was found in Deep Spring Valley, Nevada (June 9). In Nevada it was common also in Pahrump Valley (the commonest sparrow April 29), in Vegas Valley, at the Great Bend of the Colorado (where a nest containing two fresh eggs was collected May 4), along the Virgin River Valley (nests containing fresh eggs found at Bunkerville early in May), in Desert Valley just east of the Pahroc Mountains (May 20), on the plain below Pahroc Spring (May 22), in Pahranagat

Valley (May 22–26), in Indian Spring Valley, where a nest containing three eggs was found in a bush of *Atriplex canescens* May 28, and at the extreme west end of this valley, where it slopes down toward the Amargosa Desert, young just able to fly were secured May 29. It was tolerably common on the Amargosa Desert, but rare in Oasis Valley (one seen June 1). On Sarcobatus Flat, at the mouth of Grapevine Cañon, a few were seen June 2, and a few were seen on both sides of Gold Mountain (where young nearly full-grown were secured June 3). It was common in Tule Cañon, at the extreme north end of the northwest arm of Death Valley, June 4, though it does not reach the sage plain of the Mount Magruder plateau. It reappears, however, a short distance below Pigeon Spring on the northwestern slope of Mount Magruder, and ranges thence across Fish Lake Valley (June 8). In southwestern Utah it was found on both slopes of the Beaverdam Mountains, ranging up into the junipers slightly above the upper limit of the lower division of the Lower Sonoran zone. In the Lower Santa Clara Valley, Utah, it is abundant, breeding in the greasewood bushes (*Atriplex*) and in the branching cactuses (*Opuntia echinocarpa*), where several nests were found containing two or three fresh eggs each (May 11–15)."

Mr. Nelson found it breeding from the middle of the sage brush belt on the slopes of the Panamint, Grapevine, Inyo, and White mountains, down into Panamint, Mesquite, Saline, and Owens valleys. Mr. Stephens found it common near the lower end of the Argus Range, at Borax Flat, April 28–30; and in Owens Valley, at Little Owens Lake, May 6–11; at Haway Meadows, May 12–14; at Olancha, May 16–23; at Morans, July 4–7, and at Benton July 9–10.

Record of specimens collected of Amphispiza bilineata.

Collectors' No.	Sex.	Locality.	Date.	Collector.	Remark.
162	♂	Panamint Mountains, Calif	Apr. 15, 1891	A. K. Fisher	Surprise Cañon.
171	♀	do	Apr. 20, 1891	do	Do.
189	♀	Argus Range, Calif	Apr. 27, 1891	do	
332	♂	Owens Valley, Calif	June 11, 1891	do	Lone Pine.
	♀	Coso Valley, Calif	May 11, 1891	T. S. Palmer	Nest and 4 eggs.
	♂ im.	Owens Valley, Calif	June 9, 1891	do	Lone Pine.
127	♀ juv.	do	July 6, 1891	F. Stephens	Morans.
	♀ juv.	Amargosa Desert, Nev	May 29, 1891	V. Bailey	
	juv.	Gold Mountain, Nev	June 3, 1891	C. Hart Merriam	
	♂ juv.	Mount Magruder, Nev	June 4, 1891	do	

Amphispiza belli. Bell's Sparrow.

Mr. Nelson found Bell's sparrow abundant in the bushes of the arid district bordering the southern and western sides of Buena Vista Lake, in San Joaquin Valley, during October.

Amphispiza belli nevadensis. Sage Sparrow.

The sage sparrow is one of the few birds characteristic of the sage plains of the Upper Sonoran and Transition zones, but does not breed in the Lower Sonoran zone, though it winters in this zone and passes through it in great numbers during migration.

In winter it was common along the entire route of the expedition. It was seen at Cajon Pass in the San Bernardino Mountains, January 2, and on the Mohave Desert, at Hesperia, in flocks of from ten to twenty, January 4–5; at Victor, Stoddard Wells, and Daggett, January 6–10; at Granite Wells, January 13–15; at Lone Willow Spring, January 15–19. It was found in Death Valley from the lower end to Furnace Creek, January 21 to February 4; at Resting Springs, February 6–17, and at Ash Meadows, Nevada, the first three weeks in March.

Mr. Stephens found it common in Oasis Valley, Nevada, March 15–19; not common at Grapevine Spring, California, April 1–4; and Mr. Nelson found it everywhere common in Pahrump Valley about the ranch, and along the route down through Vegas Valley and Wash, to the Bend of the Colorado, March 3–16. Dr. Merriam saw a few in tree yuccas on the Mohave Desert near the mouth of Cajon Pass, March 30, and a number near Daggett, April 4–6. He noted the species at Windy Gap, April 7; in Death Valley, near Bennett Wells, April 9–12; in Mesquite Valley, April 13; Emigrant Cañon, in the Panamint Mountains, April 14 and 15, and found it common in Perognathus Flat, April 15. Perognathus Flat is a high basin in the Panamint Mountains, at the lower edge of the Upper Sonoran zone, and the species may remain there to breed. At the mouth of Johnson Cañon, in the Panamint Mountains, the writer saw this species March 25, and Mr. Bailey saw one in Wild Rose Cañon, near the 'charcoal kilns,' in the same mountains, June 25. At Hot Springs, in Panamint Valley, a few were seen in *Atriplex* bushes by Dr. Merriam, April 19–24, and one was seen at Leach Point Spring, April 25. He did not find it in the Lower Santa Clara Valley near St. George, Utah, but met with it in great abundance in passing north from this valley towards the Escalante Desert. It was one of the most characteristic birds at the upper Santa Clara Crossing, Utah, May 17, thence northward through Mountain Meadows to the Escalante Desert and Shoal Creek, and westerly across the low rolling plateau of the Juniper Mountains to Meadow Creek Valley, Nevada. It was common also in Desert Valley, Nevada, and in the neighboring Pahroc Mountains, May 20–21. A few were seen in the sage plain on Mount Magruder plateau, Nevada, June 5, and in the sage brush in Owens Valley, June 10–19. In this valley Mr. Stephens found it not common at Ash Creek, May 30–June 3; at Morans, July 4–7; and common at Olancha toward the mountains and breeding; at Independence Creek, June 18–23; at Benton, July 9–10; and was seen at Bishop Creek, August 4–10. Mr. Nelson found it common at the head of Owens River the latter part of July; on both slopes of the Inyo Mountains, from the valleys up to the middle or upper part of the piñon belt, June 24–July 4; and common in the White Mountains, up to the middle of the same belt. He did not find it in the north end of the Panamint Mountains nor in Saline Valley, but noted it on the eastern slope of the Panamint Mountains, in Cottonwood Creek, and thence down to Mesquite Valley, and also in the Grapevine Mountains, May 4 to June 15. Mr. Nelson reported the sage sparrow as very common along the route from Lone Pine to Keeler, and through the Coso and Panamint valleys to Lone Willow Spring, and thence to Death Valley, during December 1890, and January 1891.

The specimens collected along the east slope of the Sierra Nevada in Owens Valley are almost intermediate, both in size and color, between *Amphispiza belli* and *Amphispiza belli nevadensis*.

Record of specimens collected of Amphispiza belli nevadensis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
35	♂	Hesperia, Calif	Jan. 4, 1891	A. K. Fisher	Mohave Desert.
36	♂	do	do	do	Do.
42	♀	Victor, Calif	Jan. 6, 1891	do	Do.
43	♂	Stoddard Wells, Calif	Jan. 7, 1891	do	Do.
46	♀	Daggett, Calif	Jan. 9, 1891	do	Do.
47		do	do	do	Do.
2	♂	do	Feb. 6, 1891	F. Stephens	Do.
3	♂	do	do	do	Do.
4	♂	do	Feb. 7, 1891	do	Do.
5	♂	do	do	do	Do.
10	♂	do	Feb. 8, 1891	do	Do.
11	♀	do	do	do	Do.
58	♂	Granite Wells, Calif	Jan. 13, 1891	A. K. Fisher	Do.
63	♀	Lone Willow Spring, Calif	Jan. 16, 1891	do	
66		Death Valley, Calif	Jan. 21, 1891	do	Furnace Creek.
80		do	Jan. 27, 1891	do	Do.
112	♂ ad.	Resting Springs, Calif	Feb. 17, 1891	do	
27	♀	12-mile Spring Calif	Feb. 21, 1891	F. Stephens	North of Resting Springs.
	♂	Mountain Meadows, Utah	May 17, 1891	V. Bailey	
331	♂ ad.	Owens Valley, Calif	June 11, 1891	A. K. Fisher	Lone Pine.
52	♂	Salt Wells Valley, Calif	May 1, 1891	F. Stephens	
84	♂	Owens Valley, Calif	June 10, 1891	do	Olancha.
96	♂	do	June 13, 1891	do	Do.
97	♀	do	do	do	Do.
98	♀	do	do	do	Do.
99	♀	do	do	do	Do.
	im.	Sierra Nevada, Calif	Aug. 20, 1891	V. Bailey	Whitney Meadows.

Peucæa cassini. Cassin's Sparrow.

The only specimen of this species noted during the entire expedition was shot by Dr. Merriam in Timpahute Valley, Nevada, May 26. It was an old male in worn breeding plumage, and attracted his attention by flying up from the desert brush and singing in the air.

Peucæa ruficeps. Rufous-crowned Sparrow.

An immature specimen of this sparrow was secured on a rocky hillside on the South Fork of Kern River, California, July 8. Mr. Palmer saw one on the west fork of Castac Cañon June 30, and Mr. Stephens saw several migrants in Reche Cañon, near San Bernardino, Calif., September 22–24. These are all the records we have of the specis.

Melospiza fasciata fallax. Desert Song Sparrow.

The writer did not meet with this race, and quotes the following from Dr. Merriam's notes:

"The desert song sparrow was not found anywhere in California, but was common in suitable valleys in southeastern Nevada, southwestern Utah, and northwestern Arizona. It was found in the valley of the Muddy near St. Joe, Nev., May 7, and was a common breeder in Pahranagat Valley, Nevada, May 23. A specimen was shot and others seen at the mouth of Beaverdam Creek, Arizona, May 9, and it was common in the Lower Santa Clara Valley near the junction of the Santa Clara and Virgin, May 11–15, where a nest was found near a marshy meadow."

Record of specimens collected of Melospiza fasciata fallax.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Pahranagat Valley, Nev	May 23, 1891	C. Hart Merriam.	
	♂	Beaverdam, Ariz	May 9, 1891	....do	

Melospiza fasciata montana. Mountain Song Sparrow.

This song sparrow was tolerably common about the ranch at Furnace Creek, and among the reeds at Saratoga Springs, in Death Valley, in January, but was not seen at the former place in June. It was quite common at Resting Springs in the Amargosa Desert, February 6–17, and at Ash Meadows, Nevada, in March. Mr. Nelson found it common along the willow-grown banks of the ditches in Pahrump and Vegas valleys, and Mr. Stephens found it rather common in the lower end of Oasis valleys, March 15–19. Mr. Bailey reported it abundant at St. George, Utah, in January, 1889.

Record of specimens collected of Melospiza fasciata montana.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Death Valley, Calif	Feb. 3, 1891	E. W. Nelson	Saratoga Springs.
78	♂	......do	Jan. 25, 1891	A. K. Fisher	Furnace Creek.
117	♂	Ash Meadows, Nev	Mar. 4, 1891	....do	
118	♀	......do	Mar. 9, 1891	....do	
128	♀	......do	Mar. 15, 1891	....do	
33	♀	Oasis Valley, Nev	Mar. 16, 1891	F. Stephens	
34	♀	......do	....do	....do	
	♂	Pahrump Valley, Nev	Mar. 4, 1891	E. W. Nelson	
	♀	......do	....do	....do	
	♀	Vegas Valley, Nev	Mar. 12, 1891	....do	

Melospiza fasciata heermanni. Heermann's Song Sparrow.

This Californian subspecies was quite common at San Bernardino, where it was singing in the brush along streams, December 28–29, 1890. It was tolerably common in suitable localities in Owens Valley, along the South Fork of Kern River, July 3–10, and was heard singing at Kernville July 11–13. At Walker Basin it was seen along the sloughs, July 13–16, and at Bakersfield it was common along the river bottom, July 17–20. Mr. Palmer found it common near Old Fort Tejon early in July; Mr. Nelson observed it commonly in the Cañada de las Uvas and in San Emigdio Cañon the last of October; and along the route from La Panza to San Luis Obispo, October 28 to November 3.

Record of specimens collected of Melospiza fasciata heermanni.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
5	♂	San Bernardino, Calif	Dec. 28, 1890	A. K. Fisher	
	♀	San Emigdio Cañon, Calif	Oct. 22, 1891	E. W. Nelson	
396	♀ ad	Bakersfield, Calif	July 19, 1891	A. K. Fisher	
378	♀ im	Kern River, Calif	July 5, 1891	....do	25 miles above Kernville.
	♂ im	......do	July 4, 1891	V. Bailey	Do.
119	♂	Owens Valley, Calif	July 26, 1891	F. Stephens	Alvord.
67	♂	......do	May 30, 1891	....do	Ash Creek.
295	♂	......do	June 5, 1891	A. K. Fisher	Lone Pine.
302	♂	......do	June 6, 1891	....do	Do.
321	♂	......do	June 9, 1891	....do	Do.

Melospiza fasciata guttata. Rusty Song Sparrow.

Mr. Bailey secured a specimen of this song sparrow at Santa Clara, Utah, January 13, 1889. It was undoubtedly an accidental straggler from the northwest coast.

Melospiza fasciata rufina Sooty Song Sparrow.

Mr. Bailey took a specimen of this subspecies at Boulder Creek, California, on October 13, 1891, and stated that it was common there.

Melospiza fasciata graminea. Santa Barbara Song Sparrow.

Specimens of this new race, indistinguishable from Mr. Townsend's type, were taken by Mr. Nelson at Morro and Carpenteria, Calif. He found them common near the streams and wet places along the coast, and a few as far inland as Santa Paula. Whether it is a resident or a migrant from the Santa Barbara Islands, can not be decided at present.

Record of specimens collected of Melospiza fasciata graminea.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Carpenteria, Calif	Dec. 18, 1891	E. W. Nelson	
	♀	......do	....do	....do	
	♀	Morro, Calif	Nov. 8, 1891	....do	

Melospiza lincolni. Lincoln's Sparrow.

A few Lincoln's sparrows were seen at Ash Meadows, Nevada, and Mr. Nelson found it common in wet places among bushes at Vegas ranch and in Vegas Wash in March, where Dr. Merriam again saw it May 1. It was not uncommon in Johnson and Suprise cañons in the Panamint Range, April 1–20. The species was common at Hot Springs in Panamint Valley, April 20–23, and a few were seen in Shepherd Cañon, in the Argus Range, the last of April. Mr. Stephens found it breeding, but not commonly, at Independence Creek, June 18–23, and the writer saw several in the high grass at Horse Corral Meadows, August 9–13. Mr. Belding found a pair breeding in the meadow at Crockers, near the Yosemite Valley, in May, and Mr. Bailey saw a few at Monterey, September 28 to October 9.

Record of specimens collected of Melospiza lincolni.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint Mountains, Calif.	Mar. 27, 1891	E. W. Nelson	Johnson Cañon.
154	♀	do	Apr. 11, 1891	A. K. Fisher	Do.
173	♀	Panamint Valley, Calif.	Apr. 21, 1891	do	Hot Springs.
177	♂	do	Apr. 22, 1891	do	Do.
137	♀	Sierra Nevada, Calif.	June 22, 1891	F. Stephens	

Passerella iliaca unalaschcensis. Townsend's Sparrow.

Townsend's sparrow was not uncommon in Cajon Pass in the San Bernardino Mountains January 2. It was not reported again until Mr. Bailey found it common at Monterey, September 28 to October 9. Mr. Nelson found it common and generally distributed wherever thickets occurred along the coast from San Simeon to Carpenteria, November 4 to December 18.

Record of specimens collected of Passerella iliaca unalaschcensis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
23	♂	Cajon Pass, Calif	Jan. 2, 1891	A. K. Fisher	
		Morro, Calif	Nov. 8, 1891	E. W. Nelson	

Passerella iliaca megarhyncha. Thick-billed Sparrow.

The thick-billed sparrow was found commonly in a number of places in the High Sierra. Mr. Nelson reported it as rather common at the head of Owens River, and on the western slope, in July and August. Mr. Stephens saw it among the thickets at Menache Meadows May 24–26; found it common at Independence Creek, where young were taken June 20; and at the lake on Bishop Creek August 4–10. In the Sequoia National Park it was common, and several broods of young just able to fly were seen the first week in August. On the East Fork of the Kaweah River Mr. Bailey found it breeding from the lower edge of the conifers up to where *Pinus monticola* grows. It was seen at Horse Corral Meadows, August 9–13; at Whitney Meadows and Soda Springs or Kern River Lakes, the last of August; at Mineral King, September 8–11, and on the brushy hillsides about the Cañada de las Uvas and San Emigdio, October 14–28.

Record of specimens collected of Passerella iliaca megarhyncha.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
64	♀	Sierra Nevada, Calif.	May 27, 1891	F. Stephens	Summit Meadow, near Olancha Peak.
108	♀	do	June 20, 1891	do	Independence Creek.
	♀ im.	do	July 30, 1891	V. Bailey	East Fork of Kaweah River.
407	♂	do	Aug. 6, 1891	A. K. Fisher	Sequoia National Park.
411	♂ im.	do	Aug. 11, 1891	do	Horse Corral Meadows.

Passerella iliaca schistacea. Slate-colored Sparrow.

The slate-colored sparrow was not uncommon, according, to Mr. Nelson, about the heads of streams on the eastern slope of the White Mountains, where a specimen was taken, July 14. A few were seen in Johnson and Surprise cañons, in the Panamint Mountains, where a specimen was taken in the former cañon, March 28. This sparrow was not detected elsewhere by members of the expedition.

Record of specimens collected of Passerella iliaca schistacea.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint Mountains, Calif.	Mar. 28, 1891	E. W. Nelson	Johnson Cañon.
	♂	White Mountains, Calif.	July 14, 1891	do	

Pipilo maculatus megalonyx. Spurred Towhee.

The spurred towhee is common over much of the Great Basin, and also in California west of the Sierra Nevada. Mr. Nelson reported it as common among the junipers on the Charleston Mountains in the early part of March. A pair was seen in one of the cañons in the Coso Mountains, May 23, and subsequently Mr. Palmer saw others in the brush along the streams. Mr. Nelson found a few at Lone Pine in Owens Valley, in December, 1890, and the writer saw a few in the brush along the river at the same place, June 11. Dr. Merriam found it common in the northern part of the valley on the latter date. Mr. Stephens reported it as common in the lower part of the cañon at Independence Creek, where young were seen June 18–23; as not common among the piñons at Benton, July 9–10; he also saw three at Bishop Creek, August 4–10. In the Panamint Mountains, Mr. Nelson saw it in Surprise Cañon in December, 1890, and found it sparingly in the vicinity of water, where thickets of willows and rose bushes afforded it shelter, in both this range and the Grapevine Mountains during the latter part of May and the first of June. The same observer found a few in the Inyo Mountains among the piñons at Hunter's arastra, and again in willows bordering the creek near Waucoba Peak, the latter part of June; found it rather common on the west slope of the Sierra, mainly along streams; and found a few in the upper parts of the streams in the White Mountains.

In Nevada, Dr. Merriam found it in the following localities: At Mountain Spring in the Charleston Mountains, April 30; in the Juniper Mountains May 19, where it was common throughout the scrub oak and juniper down to the very edge of Meadow Creek Valley near Panaca; at Tule Cañon and on Mount Magruder, where it was abundant and a full-fledged young was shot, June 5. In Utah, he found it common among the junipers on the Beaverdam Mountains, May 11, and saw a number between the Upper Santa Clara Crossing and Mountain Meadows, in thickets of *Amelanchier* and scrub oak, May 17.

On the western slope of Walker Pass, in California, it was common July 2 and 3; along the South Fork of the Kern, July 3–10; on the hillsides in chaparral at Walker Basin, July 13–16; and at Bakersfield in the San Joaquin Valley, July 17–20.

Mr. Bailey reported it as common below the conifers on the Kaweah River the last of July, and Dr. Merriam found it common in the Granite Range in western San Diego County, July 1–10.

Record of specimens collected of Pipilo maculatus megalonyx.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Mountain Meadows, Utah	May 17, 1891	C. Hart Merriam	
	♂	Charleston Mountains, Nev	Mar. 7, 1891	V. Bailey	
	im.	Mount Magruder, Nev	June 5, 1891	do	
36	♂	Grapevine Mountains, Nev	Mar. 21, 1891	F. Stephens	
229	♂ ad.	Lone Pine, Calif	June 11, 1891	A. K. Fisher	Owens Valley.
274	♂ im.	Kern River, Calif	July 5, 1891	do	South Fork.

Pipilo maculatus oregonus. Oregon Towhee.

Mr. Nelson found the Oregon towhee sparingly along the coast of California from La Panza to San Luis Obispo the last of October; between San Simeon and Carpenteria November 4 to December 18, and common between the latter place and Santa Paula December 18 to January 4.

Pipilo chlorurus. Green-tailed Towhee.

The green-tailed towhee is a common summer resident in the mountain ranges visited by of the expedition. It was first observed in Johnson Cañon on the east slope of the Panamint Mountains, April 12, but was not seen in Surprise Cañon on the west slope during the following fortnight. In May and June Mr. Nelson found it common among the sage brush on the Panamint and Grapevine mountains, where it was associated with Brewer's sparrow. It was most numerous among the rank growth of vegetation along small streams and about springs, though it was not uncommon on the high benches among the *Artemisia tridentata*. On Willow Creek, May 24, he found a nest containing four eggs which was placed in a sage bush 15 inches from the ground. It was composed externally of rather coarse plant stems, and lined with fine fibrous rootlets and horsehair. On the north slope of

Telescope Peak, it was common as high as the upper limit of the sage brush, June 22–25.

In the Argus Range, it was common in Shepherd Cañon, where numbers were migrating the last week in April, and at Maturango Spring among the willows and other vegetation at the spring the first two weeks in May. Among the Coso Mountains it was very common along the streams and on the slopes among the sage and piñons, where the males often were heard singing from their perches on the tops of some dead brush or trees, the latter part of May. Dr. Merriam saw it on the northward continuation of the Kingston Range, between the Amargosa Desert, California, and Pahrump Valley, Nevada. He found it also in the following localities in Nevada: Tolerably common in the Charleston Mountains, April 30; at the Bend of the Colorado, May 4; very abundant on Mount Magruder, where it was breeding from the upper part of Tule Cañon up to 2,600 meters (8,500 feet) or higher, and where a dozen or more were often seen at one time, singing from the tops of sage brush and nut pines, and they were heard singing several times at night; a few were seen in the Juniper Mountains, May 19; in the Beaverdam Mountains, Utah, he found them tolerably common among the junipers, May 10–11, and in the Santa Clara Valley, Utah, May 11–15.

Mr. Nelson found the species from among the piñons up to the summit in the Inyo Mountains the latter part of June, and in the White Mountains and on the plateau at the head of Owens Valley, in July. Along the eastern slope of the Sierra Nevada it was common at the head of Owens River the last of July; at Independence Creek, where a nest containing two eggs just ready to hatch was found at the Rex Monte mill, June 18–23; at Bishop Creek, August 4–10; not common at Benton, July 9–10; and at Menache Meadows where it occurred nearly to timber line, May 24–26. The species was seen at Walker Pass, July 2; at Soda Springs or Kern River Lakes, September 3; and was common in the Sequoia National Park, during the first week of August; and in the vicinity of Mineral King, the last of August and 1st of September. Mr. Dutcher saw a few at Big Cottonwood Meadows during the summer, and Mr. Palmer found it common on Frazier Mountain among the pines, July 9, and in Tejon Pass, July 12.

Record of specimens collected of Pipilo chlorurus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
186	♂	Argus Range, Calif.	Apr. 27, 1891	A. K. Fisher	Shepherd Cañon.
230	♀	do	May 12, 1891	do	Maturango Spring.
258	♂	Coso Mountains, Calif	May 27, 1891	do	
110	♀	Owens Valley, Calif	June 20, 1891	F. Stephens	Independence Creek.
134	♂	White Mountains, Nev	July 14, 1891	do	Queen mine.

Pipilo fuscus mesoleucus. Cañon Towhee.

Mr. Bailey found the cañon towhee abundant among the hills at Mineral Park, in western Arizona, during the middle of February, 1889, and later in the same month saw a few near Fort Mohave.

Pipilo fuscus crissalis. California Towhee.

The California towhee was common among the chaparral in a number of localities west of the Sierra Nevada. At Cajon Pass, in the San Bernardino Mountains, it was very common from the lower part of the valley, well up on the divide among the oaks, January 2–3, and Dr. Merriam found it abundant at the same place, March 29–30. It was common on the western slope of Walker Pass, July 2–3; along the valley of the Kern River, July 3–13, and abundant in Walker Basin, July 13–16. Mr. Palmer reported it as abundant at Old Fort Tejon in July; Mr. Stephens at Reche Cañon, September 22–24, and Mr. Nelson as very abundant in the western foothills of the Sierra Nevada in August. It was common at Three Rivers, July 25–30, and September 12–15, and Mr. Bailey noted it along the East Fork of the Kaweah River nearly up to the lower edge of the pines. The same observer found it common at Monterey the first week in October; Mr. Nelson reported it as abundant among the brush along the western edge of the San Joaquin Valley in October, and along the coast from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Pipilo fuscus crissalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
[illegible]	♀	San Bernardino, Calif	Jan. 1, 1891	A. K. Fisher	
[illegible]	♂	do	do	do	
[illegible]	♂	Argus Range, Calif	Apr. 25, 1891	F. Stephens	Searl's Garden.
[illegible]	♀ ad.	Walker Pass, Calif	July 2, 1891	A. K. Fisher	
	Im.	do	July 3, 1891	V. Bailey	
	♀ im.	do	do	do	
372	♂ ad.	Kern River, Calif	July 4, 1891	A. K. Fisher	South Fork.
	♂	Ventura River, Calif	Dec. 20, 1891	E. W. Nelson	

Pipilo aberti. Abert's Towhee.

The westernmost locality at which Dr. Merriam and Mr. Bailey saw Abert's towhee is the Bend of the Colorado River, in Nevada, where it was common, and a full grown young was secured, May 4. Thence northward they found it common in the valleys of the Virgin and lower Muddy, May 6–8, where Beaverdam Creek joins the Virgin in northwestern Arizona, May 9–10, and in the Lower Santa Clara Valley, Utah, near St. George, May 11–15, where it was breeding commonly.

Habia melanocephala. Black-headed Grosbeak.

The black-headed grosbeak was first observed in Shepherd Cañon in the Argus Range, where a specimen was secured April 26. A week later it was common among the willow patches at Maturango Spring and among the tree yuccas at the western base of the range. In the Coso Mountains several were seen in the cañons during the latter part of May. Mr. Nelson found it a common breeding bird both in the Panamint and Grapevine mountains, and the writer saw a fine male in full song at the 'charcoal kilns' in Wild Rose Cañon, north of Telescope Peak, June 23. In Owens Valley Mr. Stephens found it rather common at Olancha, May 16–23; not common at Ash Creek, May 30 to June 3, and saw one male at Independence Creek, June 18–23. Mr. Nelson found it sparingly among the willows in the Inyo Mountains, June 24 to July 5, and along the western slope of the Sierra Nevada in August. Mr. Bailey reported this grosbeak as common among the pines along the East Fork of the Kaweah River, July 25 to August 10. It was observed on the western slope of Walker Pass, June 21; was common in Kern Valley, June 22–23 and July 3–10; on the ridge above Walker Basin, July 14; in the Sierra Liebre, June 30; and in Cañada de las Uvas, June 28–29.

In Nevada Dr. Merriam found a pair breeding in a thicket near Log Spring on Mount Magruder, June 8; saw it in Oasis Valley, June 1; in the valley of the Virgin near Bunkerville, May 8; and found it common in Pahranagat Valley, where it was singing in the tall cottonwoods, May 22–26. In Utah he found it breeding plentifully along the Lower Santa Clara River, May 11–15.

Record of specimens collected of Habia melanocephala.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
184	♂	Argus Range, Calif	Apr. 26, 1891	A. K. Fisher	Shepherd Cañon.
240	♂	do	May 14, 1891	do	Maturango Spring.
	♀	do	May 15, 1891	T. S. Palmer	Do.

Guiraca cærulea eurhyncha. Western Blue Grosbeak.

The blue grosbeak is tolerably common in many of the valleys of Cal- fornia and Nevada. In Nevada, Dr. Merriam found it breeding con- monly in Pahranagat Valley, May 22–26, and along the Lower Mudd and Virgin rivers, May 7 and 8. He saw several where Beaverdam Cree joins the Virgin River in northwestern Arizona, May 9–10, and foun the species common in the Lower Santa Clara Valley, Utah, May 11–1 Several were seen in the Cañada de las Uvas, California, June 28–2 At Lone Pine, in Owens Valley, it was quite common among the fru orchards and thick growth along streams, where two young just out the nest were secured, June 14. Mr. Stephens found it more or le common in the same valley, at Olancha, May 16–23; Ash Creek, M 30 to June 3; Alvord, June 26–28; and at Morans, July 4–7. Mr. Bail secured an adult male at Furnace Creek ranch, Death Valley, June and Mr. Nelson saw the species in Saline Valley the latter part of the same month. Blue grosbeaks were very common along the South Fork of the Kern, where they frequented the oat fields and the thick vegetation in the river bottoms, July 3–10. They were also common at Kernville, July 11–13; at Walker Basin, July 13–16; and at Bakersfield in the San Joaquin Valley, July 17–20.

Record of specimens collected of Guiraca cærulea eurhyncha.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	St. George, Utah	May 14, 1891	V. Bailey	
	♀	Beaverdam, Ariz	May 9, 1891	....do	
	♂	Bunkerville, Nev	May 8, 1891	C. Hart Merriam	
	♂	Death Valley, Calif	June 19, 1891	V. Bailey	Furnace Creek.
	♂	Owens Valley, Calif	June 5, 1891	T. S. Palmer	Lone Pine.
313	♂	......do	June 7, 1891	A. K. Fisher	Do.
316	♂	......do	June 8, 1891	....do	Do.
338	♀ juv	......do	June 14, 1891	....do	Do.
339	♀ juv	......do	....do	....do	Do.
66	♂	......do	May 30, 1891	F. Stephens	Ash Creek.
85	♀	......do	June 11, 1891	....do	Olancha.
93	♂	......do	June 12, 1891	....do	Do.
104	♀	......do	June 15, 1891	....do	Do.
121	♂	......do	June 27, 1891	....do	Alvord.
373	♂	Kern River, Calif	July 4, 1891	A. K. Fisher	South Fork.
379	♂ ad	......do	July 5, 1891	....do	Do.
384	♂ ad	......do	July 10, 1891	....do	Do.

Passerina amœna. Lazuli Bunting.

The lazuli bunting is a common breeder in many places in the Great Basin wherever there is sufficient water to produce a growth of willow or other thickets suitable for nesting sites.

In Nevada, Dr. Merriam found it breeding commonly on Mount Magruder, and in the thickets in Tule Cañon, June 4–8; in Pahranagat Valley, May 22–26, and saw a few in the Juniper Mountains, May 18, and in Oasis Valley, June 1. He found it common at the Bend of the Colorado, May 4, and at a few points in the valleys of the Muddy and Virgin rivers, May 7–8. In the Santa Clara Valley, Utah, it was an abundant breeder, May 11–15.

The writer first met with the species at Coso, Calif., where a male was secured May 25. At Furnace Creek, Death Valley, a female was secured in the brush near the ranch, June 19, and the species was common in Wild Rose Cañon in the Panamint Mountains, June 24 and 25. Mr. Nelson found it common in both the Panamint and Grapevine mountains, wherever willow thickets occurred. It was nesting in Mill Creek, Willow Creek, and Cottonwood cañons in the former, and in Wood Cañon in the latter range of mountains. The same observer found it from the bottom of the valley up to the piñons in the Inyo Mountains; at the head of Owens Valley, near the White Mountains, and along borders of streams from the foothills up to 2,450 meters (8,000 feet) altitude at the head of Owens River. In Owens Valley it was common about the orchards at Lone Pine in June; and Mr. Stephens saw several at

Olancha, May 16–23; found it common at Ash Creek, May 30–June 3; at Morans, July 4–7; abundant in the lower part of the cañon of Independence Creek, June 18–23; not common at Alvord, June 26–28; at Benton, July 9–10; at Queen station in the White Mountains, Nev., June 11–16; and saw a male at about 2,450 meters (8,000 feet) altitude, at Bishop Creek, August 4–10. Mr. Palmer secured a specimen at Horse Corral Meadows, August 11, and saw another in Kings River Cañon, August 15; and Mr. Bailey saw two at 2,450 meters (8,000 feet) altitude on the Kaweah River, about the same time. Mr. Palmer found it common at Old Fort Tejon, where a nest containing three fresh eggs was found in a willow tree 6 feet from the ground, July 4. The species was common along the valley of the Kern, July 3–13; at Walker Basin, July 13–16; and at Bakersfield in the San Joaquin Valley, July 17–20.

Record of specimens collected of Passerina amœna.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
256	♂	Coso, Coso Mountains, Calif.	May 25, 1891	A. K. Fisher	
301	♂	Owens Valley, Calif	June 6, 1891	....do	Lone Pine.
341	♀	Death Valley, Calif	June 19, 1891	....do	Furnace Creek.

Calamospiza melanocorys. Lark Bunting.

A few miles north of Pilot Knob on the Mohave Desert, California, a lark bunting was killed by Mr. F. W. Koch April 6, and two others were seen by Dr. Merriam. One was shot in Pahrump Valley, Nevada, April 29, by Mr. Bailey. No others were observed by any members of the expedition.

Piranga ludoviciana. Western Tanager.

The western tanager was found commonly in many places during migration, and sparingly during the breeding season. The first individual observed was secured by Dr. Merriam in Surprise Cañon in the Panamint Mountains, California, April 23. When first seen it was in hot pursuit of a large beetle, which it failed to capture. At Maturango Spring in the Argus Range, a large flight of these tanagers occurred on May 4, where as many as a dozen males were seen at one time. From this date until the time of leaving, the middle of May, it was common among the willows in the vicinity of the spring. In the Coso Mountains a pair was seen near the top of the ridge, where they were evidently hunting for a nesting site, May 23. Mr. Nelson found it a rather common breeding species among the piñons on Willow Creek in the Panamint Mountains, and also in Mill Creek and Cottonwood cañons, though in smaller numbers, during the last of May. He saw none in the Grapevine Mountains.

Dr. Merriam saw two males of this species and one hepatic tanager in a tall cottonwood at the point where Beaverdam Creek joins the Virgin

River, in northwestern Arizona, May 9. He saw many males in the Lower Santa Clara Valley, Utah, May 11–14; six males in the Juniper Mountains, Nevada, May 18, and several in Pahranagat Valley, May 22–26.

At Keeler, early in June, an individual alighted for a few moments on the wagon during a gale. In the same valley a few were seen and two secured at Lone Pine, June 6–8; Mr. Stephens reported it a rather common migrant at Olancha May 16–23; not common at Bishop August 4–10, and rather common at Menache Meadows May 24–26. Mr. Nelson found it at the head of Owens River the latter part of July; several were seen among the hills above Walker Basin July 14, and several were observed in the Sequoia National Park during the first week of August. Mr. Palmer saw one in Tejon Pass July 12.

Record of specimens collected of Piranga ludoviciana.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Mountains, Calif.	Apr. 23, 1891	C. Hart Merriam	Surprise Cañon.
135	♂	Argus Range, Calif.	May 4, 1891	A. K. Fisher	Maturango Spring.
[illegible]	♂	do	May 10, 1891	do	Do.
[illegible]	♂	do	do	do	Do.
[illegible]	♂	do	do	do	Do.
[illegible]	♂	Coso Mountains, Calif.	May 23, 1891	do	
[illegible]	♀	Owens Valley, Calif.	June 6, 1891	do	Lone Pine.
[illegible]	♂	do	June 8, 1891	do	
71	♂	do	June 1, 1891	F. Stephens	Owens Lake.
[illegible]	♂	Sierra Nevada, Calif.	July 27, 1891	do	

Piranga hepatica. Hepatic Tanager.

The only individual of this species observed during the entire season was seen by Dr. Merriam in a cottonwood at the point where Beaverdam Creek empties into the Virgin in northwestern Arizona, May 9. Two adult male western tanagers (*P. ludoviciana*) were in the same tree, and both species were probably migrating.

Progne subis hesperia. Western Martin.

A colony of martins was found breeding at Old Fort Tejon in the Cañada de las Uvas, California, June 28, 1891, by Dr. Merriam and Mr. Palmer. They were nesting in woodpeckers' holes in the large oaks in front of the old fort, where three were killed. Mr. Belding noted the species at Crocker's, 21 miles northwest of the Yosemite Valley, in May.

Record of specimens collected of Progne subis hesperia.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂ ad.	Old Fort Tejon, Calif.	June 28, 1891.	C. Hart Merriam.	
	♂ im.	do	do	do	
	♂ im.	do	do	do	

Petrochelidon lunifrons. Cliff Swallow.

This widely distributed species was found breeding in various localities visited by the expedition. In Nevada Dr. Merriam found a colony breeding in the cañon at the lower end of Vegas Wash, May 3, and saw several at the Bend of the Colorado, May 4; he found it common in Pahranagat Valley, May 22–26, and in Oasis Valley, June 1. In Utah he saw a colony which was breeding near St. George, in the Lower Santa Clara Valley, where many nests were found on the red sandstone cliffs a mile or two from the settlement.

The cliff swallow was common in Owens Valley, California. It was seen along the edge of the lake at Keeler, May 30–June 4; at the mouth of the cañon above Lone Pine, June 12; and Mr. Stephens found it common at Haway Meadows, May 12–14; abundant at Olancha, May 16–23; at Ash Creek, May 30 to June 3; breeding in the cañon at Benton, July 9–10; and not common at the Queen mine, Nevada, July 11–16. Mr. Nelson saw it on Willow Creek in the Panamint Mountains, the last of May, and found it at the head of Owens River, in the Sierra Nevada, up to 2,100 meters (7,000 feet) altitude. It was common in Kern Valley, July 3–13, and in Walker Basin, July 13–16. At the latter place a number of nests were found fastened against the ceiling and walls of the rooms in several of the deserted buildings. Dr. Merriam found it breeding commonly at Kernville, under the eaves and piazzas of houses, June 23, and in the Cañada de las Uvas, under the eaves of Old Fort Tejon, June 28–29.

At Twin Oaks, in western San Diego County, he was shown a large sycamore tree on the outside of which these swallows used to fasten their nests, and was told that after heavy rains the nests were frequently washed down in great numbers. The species was common at Bakersfield, in the San Joaquin Valley, July 17–20, and Mr. Stephens found it not uncommon at Reche Cañon, near San Bernardino, September 22–24.

Chelidon erythrogaster. Barn Swallow.

The barn swallow was found nowhere common except in Owens Valley, California. It was first seen at Ash Meadows, Nevada, where two were noted, March 19. In the same State, Dr. Merriam saw one at Mount Magruder, June 8; one in Oasis Valley, June 1; a number in Pahranagat Valley, May 22–26, where it was doubtless breeding, and several near Bunkerville, in the Virgin Valley, May 7–8. He saw a single bird near St. George, in the Lower Santa Clara Valley, Utah, about the middle of May.

Mr. Nelson saw it as a migrant on the divide between Panamint and Saline valleys, the last of May, and at the head of Willow Creek, in the Panamint Mountains, about the same time. He saw barn swallows at the head of Owens Valley in the White Mountains, at the head of *Owens River*, and also in the Yosemite Valley. Mr. Stephens found it common all through Salt Wells and Owens valleys, and the writer found it common in the latter valley at Keeler, near Owens Lake, and at Lone Pine, in June. At Keeler a male was noticed every day during our stay. He sat for hours on a wire in front of the signal station and produced a series of notes which were well worth the title of a song. The sounds were more or less disconnected, but the writer does not remember hearing so perfect a song from any swallow, and as Mr. Bicknell states (Auk, Vol. I, 1884, p. 325) the notes suggest those produced by the marsh wren.

Tachycineta bicolor. Tree Swallow.

White-bellied swallows were seen in a few places during migration. Several were seen at Ash Meadows, Nevada, March 12, and a number near the Colorado River, March 10–13. At Furnace Creek, Death Valley, it was common about the reservoir, March 23–24, and again the middle of April. A few were seen in Johnson Cañon in the Panamint Range, April 4, and Mr. Nelson observed stragglers at the head of Willow Creek in the same range, the last of May.

Tachycineta thalassina. Violet-green Swallow.

The violet-green swallow is a common summer resident among the mountains and was frequently seen in the neighboring valleys while searching for food. Two or three were seen near the upper end of Vegas Wash, Nevada, March 10, and many were observed in Death Valley, at Furnace Creek, April 10, and at Saratoga Springs, near the south end, April 26. In Nevada, Dr. Merriam found it common in Pahranagat Valley, May 22–26, saw it on Mount Magruder, June 8, and in Oasis Valley, June 1. In Utah it was common in the Lower Santa Clara Valley, May 11–15. Mr. Nelson found it a common species in the Panamint and Grapevine mountains, where it bred in the crevices of the lofty cliffs, from the summits down to the border of the surrounding valleys. In the former range violet-green swallows were common, and a specimen was secured on the summit of Telescope Peak, June 23. In the Argus Range it was common about the summit above Maturango Spring, May 12–14, and at Coso, four or five came about camp, May 28.

Mr. Nelson saw the species from the lower part of Saline Valley to the summit of the Inyo Mountains, in June; up to timber line in the White Mountains, in July, and at the heads of Owens and Merced rivers, in the Sierra Nevada, in July and August. In Owens Valley this swallow was common about the lake at Keeler and at Lone Pine during the first half of June. At the latter place it was seen flying about in company with the cliff swallows, white-throated and cloud swifts, at the mouth of the cañon, and with the barn swallows over the meadows and marshes. Mr. Stephens found it more or less common in other parts of the valley. It was common along the valley of Kern

River, July 3–13; in Walker Basin, July 13–16, and along the route to Bakersfield, July 16–20. Dr. Merriam and Mr. Palmer found it abundant at Old Fort Tejon, where it was breeding in the oaks and crevices of the adobe buildings; it was very common about the summit of Frazier Mountain, July 9, and at the summit of Tejon Pass, July 12. In the High Sierra it was common about the openings at Horse Corral Meadows, August 9–13; in Kings River Cañon, August 13–16; Big Cottonwood Meadows, August 25–26; at Soda Springs or Kern River Lakes, September 3, and above timber line at Mineral King, and along the route from that place to Three Rivers in the western foothills, September 10–13. Mr. Bailey found the species numerous at Monterey, September 28 to October 9, and Mr. Stephens saw several at Reche Cañon, September 22–24.

Record of specimens collected of Tachycineta thalassina.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
269	♀	Coso, Coso Mountains, Calif.	May 28, 1891	A. K. Fisher	
272	♀	Keeler Inyo County, Calif.	June 1, 1891	do	
293	♂	do	do	do	
286	♂	do	June 2, 1891	do	
287	♀	do	do	do	
354	♂	Panamint Mountains, Calif.	June 23, 1891	do	Telescope Peak.

Clivicola riparia. Bank swallow.

Bank swallows were seen in two places only by members of the expedition. Mr. Nelson saw a few in company with rough-winged swallows at the Bend of the Colorado, in Nevada, about March 10. Mr. Stephens found it common at Alvord, in Owens Valley, where they were breeding in the banks along the sloughs, June 26–28.

Stelgidopteryx serripennis. Rough-winged Swallow.

The rough-winged swallow was tolerably common in a number of the desert valleys, where it was a summer resident. It was first seen at Ash Meadows, Nevada, March 10, and in Vegas Wash, near the Bend of the Colorado River, March 10–13. A specimen was secured at Hot Springs, in Panamint Valley, April 22, and Mr. Nelson observed a few migrants along Willow Creek, in the Panamint Mountains, the last of May. Dr. Merriam saw this swallow at Saratoga Springs in Death Valley, April 26; at the Bend of the Colorado River, May 4; in the Valley of the Virgin near Bunkerville, Nevada, May 8; and in Pahranagat Valley Nevada, where it was tolerably common and doubtless breeding, May 22–26. He found it common where Beaverdam Creek joins the Virgin in northwestern Arizona, May 9–10, and the commonest swallow in the Santa Clara Valley Utah, May 11–15. In Owens Valley a pair was seen about a pond at Lone Pine, June 8, and others were observed at Big Pine June 10. At Furnace Creek, Death Valley, several were secured about the reservoir June 19–21, and a number were seen in Kern River Valley June 22–23.

Record of specimens collected of Stelgidopteryx serripennis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
176	♂	Panamint Valley, Calif.	Apr. 22, 1891	A. K. Fisher	Hot Springs.
340	♂ im.	Death Valley, Calif	June 19, 1891	do	Furnace Creek.
	♀ im.	do	do	V. Bailey	Do.

Ampelis cedrorum. Cedar Waxwing.

The only cedar birds observed during the entire trip were two seen at Lone Pine, in Owens Valley, June 14, and a flock of five, at Three Rivers, Tulare County, September 15. At the former place they were feeding on mulberries, which were cultivated along one of the irrigating ditches of a fruit ranch. This berry, when it can be obtained, seems to be their favorite food, and one which they will take in preference to any other. Among the Creoles of Louisiana the knowledge of this fact has given rise to the name of *mûrier* for the cedar bird in that locality.

At Three Rivers the specimens secured were gorged with a small wild grape (*Vitis californica*), which was ripening in abundance in the low thickets along the streams.

Phainopepla nitens. Phainopepla.

This species is a characteristic bird of the Lower Sonoran zone, where it remains throughout the year. Several were seen among the mesquite at Hot Springs in Panamint Valley, in January, and a fine male was secured at the mouth of Surprise Cañon, not far from the above place, April 23. Its stomach was filled with the berries of the mistletoe, which is a parasite on the mesquite. Several were seen at Resting Spring in the Amargosa Desert, about the middle of February, feeding on the same berries, which appear to be their principal food.

An adult male was seen at Maturango Spring in the Argus Range, May 10, and one or two were observed at Coso the latter part of May. Mr. Nelson found it rather common in the lower part of Vegas Valley and upper part of Vegas Wash and very abundant in the lower part of the Wash, near the Colorado River, in March. It was seen by Dr. Merriam at Mountain Spring in the Charleston Mountains, April 30, and was common in the Lower Santa Clara Valley, Utah, June 11–15, where several pairs were breeding in the village of St. George. An adult female was seen by Mr. Stephens at Morans, in Owens Valley, July 4–7, and Mr. Nelson found it rather common in the western foothills of the Sierra Nevada, between the San Joaquin and Merced rivers in August. One was seen in the chaparral above Kaweah, July 25, and another July 30.

At Kernville the species was abundant in cañons above the village July 11–13, where as many as a dozen were seen at once, some sitting on the tree tops, while others were busily engaged in capturing winged insects after the manner of the cedar bird.

Dr. Merriam met with unusual numbers among the live oaks and chaparral between Kernville and Havilah, June 23; saw many in Walker Basin June 24, and several in Tehachapi Pass June 25. He also noted it as common in the Sierra Liebre June 30, and in the Granite Range, in western San Diego County, July 1–10.

Mr. Palmer saw several in the San Francisquito Pass, north of Newhall, July 1, and Mr. Nelson found it common among the piñons a few miles west of the Cañada de las Uvas, the middle of October.

Mr. Bailey found a nest containing three fresh eggs in a mesquite, near Fort Mohave, Ariz., March 4, 1889, and one containing young, several days old, February 28.

Record of specimens collected of Phainopepla nitens.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
109	♀	Resting Springs, Calif.	Feb. 12, 1891	A. K. Fisher	
183	♂	Panamint Mountains, Calif.	Apr. 23, 1891	do	Surprise Cañon.

Lanius ludovicianus excubitorides. White-rumped Shrike.

The white-rumped shrike is very generally distributed over the greater part of the desert region of southern California and Nevada. From its habit of associating in pairs and not congregating in flocks, it is seldom common in the sense that other birds are, though a considerable number may be seen in the course of a day's ride through suitable localities. It is especially partial to the country covered by tree yuccas and seldom builds its nest in other growths where these abound. Many old as well as new nests were found which were so well protected by the strong, bayonet-like leaves of this plant that it was with difficulty they could be reached. The species was tolerably common at Hesperia in the Mohave Desert, January 4–5, and at Granite Wells, about the middle of January. At Furnace Creek and Saratoga Springs, in Death Valley, several were seen the last of January.

At Resting Springs, California, a number were seen each day during the first half of February, and at Ash Meadows, Nevada, in March. It was not uncommon in Vegas Valley, Nevada, where Mr. Nelson found a small *Perognathus* and lizard impaled on thorns by it. In Coso Valley, California, the writer observed a number of insects and lizards fastened on the sharp-pointed leaves of the yuccas. In the latter place several nests containing eggs were found in the tree yuccas during the first half of May, and one near Darwin, in the north end of the valley, June 17. In the Coso Mountains shrikes were in sight most of the time, and a nest containing four young was found May 27. Four other young, just able to fly, were seen on the same date.

In Nevada Dr. Merriam found a nest containing six eggs on the east slope of the Pahranagat Mountains, May 26. It was so placed in a fork *of a tree yucca* that although easily seen it could not be reached from any direction. He found the species at Mountain Spring in the Charleston Mountains, April 30; in Desert Valley, May 20; in the Juniper Mountains, May 18–19; and on Gold Mountain, among the yuccas on the south slope, June 3. On Mount Magruder several were seen in Tule Cañon, and thence up to an altitude of 2,450 meters (8,000 feet) in the nut pines, where it evidently was breeding, June 4–8. In Utah it was seen in the Santa Clara Valley near St. George, May 11–15; at Mountain Meadows, May 17; and among the tree yuccas on the south slope of the Beaverdam Mountains, May 10. Several were seen in the nut pines on the White and Inyo mountains, California.

In Owens Valley the species was quite common and numbers of young birds were seen about the orchards and roadsides in June. Mr. Nelson found it breeding in the Panamint, Grapevine, Inyo, and White mountains and the adjacent valleys, and Dr. Merriam saw several in the clumps of mesquite, in Death Valley and Mesquite Valley, April 8–18

It was common in Kern River Valley, Walker Pass, and Walker Basin, and in the San Joaquin Valley between Bakersfield and Visalia. It is a question whether the individuals seen by the writer at San Bernardino, December 27–30, 1890; by Dr. Merriam in the southern part of San Diego County, July 1–10, and by Mr. Nelson along the route from San Simeon to Carpenteria and Santa Paula should not be referred to the California shrike (*Lanius ludovicianus gambeli*).

Record of specimens collected of Lanius ludovicianus excubitorides.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
37	♂	Hesperia, Calif	Jan. 4, 1891	A. K. Fisher	Mohave Desert.
61	♂	Granite Wells, Calif	Jan. 15, 1891	do	Do.
97	♀	Death Valley, Calif	Feb. 3, 1891	do	Furnace Creek.
118	♂	Ash Meadows, Nev	Mar. 4, 1891	do	
[illegible]	♀	Twelve-mile Spring, Calif	Feb. 21, 1891	F. Stephens	North of Resting Springs.
292	♂ juv.	Coso Mountains, Calif	May 27, 1891	A. K. Fisher	
293	♀ juv.	do	do	do	
294	♀ juv.	do	do	do	
296	♂ juv.	Owens Valley, Calif	June 5, 1891	do	Lone Pine.
[illegible]	♀	do	May 13, 1891	F. Stephens	Haway Meadows.
[illegible]	♂ juv.	do	do	do	Do.
[illegible]	♀	do	June 19, 1891	do	Independence Creek

Vireo gilvus swainsoni. Western Warbling Vireo.

The warbling vireo was seen with very little regularity and was common in few localities visited by the expedition. In Owens Valley Mr. Stephens saw one among the willows at Haway Meadows, May 13; found it common and migrating at Olancha, May 16–23; common in the lower part of the cañon of Independence Creek, June 18–23; and heard several among the willows at the Queen mine in the White Mountains, Nevada, July 11–16. At Coso one was seen among the willows and rose bushes bordering a spring, May 23, and two were secured at the same place the following day. Dr. Merriam shot a specimen in worn breeding-plumage at Ash Meadows, Nevada, May 30, and saw a pair at Kernville, in Kern River Valley, June 23. It was not uncommon among the hills above Walker Basin, July 14, and Mr. Nelson noted a few at the head of Owens River the latter part of the month. Mr. Palmer found it common at Old Fort Tejon, where a nest containing four eggs, just ready to hatch, was discovered in a willow 10 or 12 feet from the ground, July 4.

Record of specimens collected of Vireo gilvus swainsoni.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
252	♂	Coso, Coso Mountains, Calif	May 21, 1891	A. K. Fisher	
253	♂	do	do	do	

Vireo solitarius cassinii. Cassin's Vireo.

Cassin's vireo was observed in a number of places in the Sierra Nevada and sparingly in some of the other ranges. Dr. Merriam took a specimen in worn breeding-plumage, June 28, at Old Fort Tejon, in the Cañada de las Uvas, California, the type locality of the species. At Maturango Spring, in the Argus Range, a specimen was taken among the piñons, May 8. Mr. Nelson found it common at the head of Owens River and Dr. Merriam shot one among the junipers at Sheep Spring in the Juniper Mountains, Nevada, May 19. It was observed among the pines above Walker Basin, July 14; was common in the Sequoia National Park during the first week in August; was seen at Horse Corral Meadows, August 11; common at Kings River Cañon, August 13–16; and one was secured at Big Cottonwood Meadows, September 5.

Record of specimens collected of Vireo soliturius cassinii.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Juniper Mountains, Nev	May 19, 1891	C. Hart Merriam	
210	♀	Argus Range, Calif	May 8, 1891	A. K. Fisher	Maturango Spring.
	♂	Old Fort Tejon, Calif	June 28, 1891	T. S. Palmer	
393	♀	Walker Basin, Calif	July 14, 1891	A. K. Fisher	
157	♀ im.	Sierra Nevada, Calif	Aug. 22, 1891	F. Stephens	Olancha Peak.

Vireo solitarus plumbeus. Plumbeous Vireo.

The only specimen of this vireo taken on the expedition was a male secured by Dr. Merriam at Sheep Spring in the Juniper Mountains, Nevada, May 19, 1891. It was in full song and was shot in the same tree in which a Cassin's vireo was killed a few minutes before.

Vireo bellii pusillus. Least Vireo.

The least vireo is a tolerably common summer resident in Owens Valley, where at Lone Pine adult and young were secured in June; it was seen by Mr. Stephens at Olancha, May 16–23, and at Bishop Creek, August 4–10. A specimen was secured at Furnace Creek, Death Valley, June 20, and the species was not uncommon in the cañon above the ranch the following day. West of the Sierra Nevada, it was common at Bakersfield, in the San Joaquin Valley, July 17–20.

Record of specimens collected of Vireo bellii pusillus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Ash Meadows, Nev.	May 30, 1891	V. Bailey	
343	♂	Death Valley, Calif.	June 20, 1891	A. K. Fisher	Furnace Creek.
351	♂	....do	June 21, 1891	....do	Do.
318	♀	Owens Valley, Calif	June 8, 1891	....do	Lone Pine.
328	♀ juv.	....do	June 11, 1891	....do	Do.
397	♂	Bakersfield, Calif.	July 19, 1891	....do	

Vireo vicinior. Gray Vireo.

Mr. Nelson found this vireo rather common in the Grapevine Mountains, Nevada, where he secured a specimen June 8. In Wood Cañon, he saw several among the piñons, and on June 10 observed one carrying material for its nest. This is the only locality at which the bird was found.

Helminthophila luciæ. Lucy's Warbler.

This rare warbler breeds in the Lower Santa Clara Valley in southwestern Utah, where two specimens were shot by Dr. Merriam, May 11 and 13, the former in cottonwoods along the Santa Clara River and the latter at a small pond near the village of St. George.

Record of specimens collected of Helminthophila luciæ.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Santa Clara, Utah	May 11, 1891	C. Hart Merriam	
	♀	St. George, Utah	May 13, 1891	....do	

Helminthophila ruficapilla gutturalis. Calaveras Warbler.

The Calaveras warbler, with the exception of a pair seen in Shepherd Cañon in the Argus Range, California, April 29, was seen only in the Sierra Nevada. It was common in the Sequoia National Park during the first week of August, and a few were seen at Round Valley, 12 miles south of Mount Whitney, August 28. Mr. Nelson found it common at the head of Owens River and also on the western slope in the Yosemite Valley, in July and August.

Record of specimens collected of Helminthophila ruficapilla gutturalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
134	♀	Argus Range, Calif.	April 29, 1891	A. K. Fisher	Shepherd Cañon.
435	......	Sierra Nevada, Calif.	Aug. 4, 1891	....do	Sequoia National Park.

Helminthophila celata lutescens. Lutescent Warbler.

This active little warbler was found to be abundant in a few plac during migration. At San Bernardino one was seen on the border a stream, December 29, 1890. In the Panamint Mountains it was se in Johnson Cañon, April 12; by Mr. Nelson among the willows at t heads of Willow and Mill creeks, the last of May; and by Mr. Bail and the writer near the 'charcoal kilns' at the head of Wild Rose Cañc June 23. In the Argus Range, it was common both in Sheplie Cañon and at Maturango Spring the first half of May. Mr. Stephe saw a few migrating by Little Owens Lake, May 6–11; and at Haw Meadows, May 12–14.

It was common along the South Fork of the Kern, July 3–10. the High Sierra it was abundant in the Sequoia National Park, the fir week in August; common at Horse Corral Meadows, August 9–13; Round Valley, 12 miles south of Mt. Whitney, August 28; and at Mi eral King, September 10–11. Mr. Nelson found it common at the he of Owens River and in the Yosemite Valley in July and August.

Record of specimens collected of Helminthophila celata lutescens.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
215	♀	Argus Range, Calif	May 8, 1891	A. K. Fisher	Maturango Sprin
216	♂	......do	May 9, 1891	....do	Do.
217	♂	......do	....do	....do	Do.
	♂ im	Panamint Mountains, Calif.	June 21, 1891	V. Bailey	Coal kilns.
	♂ im	Sierra Nevada, Calif	Aug. 3, 1891	E. W. Nelson	South Fork Mer River.
159	♀ im	......do	Aug. 22, 1891	F. Stephens	Olancha Peak.

Dendroica æstiva. Yellow Warbler.

The yellow warbler was tolerably common in a number of localiti visited by members of the expedition. Mr. Nelson found it a rath common breeding species among the willows along Willow Creek, M Creek, and Cottonwood Creek cañons in the Panamint Mountains, a noted a few in Wood Cañon in the Grapevine Mountains. The sa observer found it common at the head of Owens Valley at the base the White Mountains and up to 2,600 meters (8,500 feet) altitude the head of Owens River, in the Sierra Nevada. The writer first o served the species at Coso, where an adult male was seen busily e gaged catching insects among some willows and rose bushes on t evening of May 24 and the following morning.

At Lone Pine, in Owens Valley, yellow warblers were common amo the orchards and shade trees, June 4–15. In the same valley, M Stephens found it common at Independence Creek, June 18–24; not co mon at Benton, July 9–10, and the Queen mill, Nevada, July 11–16, a saw two or three individuals in the cottonwoods at Morans, July 4-

In Nevada, Dr. Merriam shot a male in Pahrump Valley, on a so tary mesquite bush at a small spring six miles south of Yount's ranc

April 29. He saw others at Upper Cottonwood Springs, at the east base of the Charleston Mountains, April 30; at Vegas ranch, May 1; at the Bend of the Colorado River, May 4; in the valley of the Virgin and Lower Muddy, May 6 and 8, and on Mount Magruder, June 4–8. In Pahranagat Valley it was breeding commonly, May 22–26, this being the only locality in Nevada at which he observed it in any numbers. He found it common where Beaverdam Creek joins the Virgin in northwestern Arizona, May 10, and breeding plentifully in the Lower Santa Clara Valley, Utah, near St. George, May 11–15. Mr. Palmer found it very common at Old Fort Tejon the first of July. All through Kern Valley, Walker Basin, and at Bakersfield, in the San Joaquin Valley, this warbler was common in the willows along the streams during the first three weeks of July, and sparingly in the latter valley as late as October.

Record of specimens collected of Dendroica æstiva.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
30	♂	Owens Valley, Calif	June 5, 1891	A. K. Fisher	Lone Pine.
34	♂	do	June 12, 1891	F. Stephens	Olancha.
128	♀	do	July 9, 1891	do	Benton.
129	♂ juv	do	do	do	Do.

Dendroica auduboni. Audubon's Warbler.

The western yellow-rumped warbler was common as a migrant in various localities and not uncommon as a breeder in some of the mountain ranges. At San Bernardino a flock was seen in a clump of willows, and a number associated with chipping sparrows were seen gleaning insects from a field of early cabbage, December 28, 1890. A few were found among the willows bordering the reservoir at Furnace Creek, Death Valley, California, during the latter part of January, and again on April 10, and a single one was seen at Ash Meadows, Nevada, March 21. It was not uncommon at Hot Springs in Panamint Valley, April 20–23, and at Maturango Spring, in the Argus range, the first half of May.

In Nevada Audubon's warbler was seen by Mr. Nelson at Pahrump and Vegas ranches in February and March; and by Dr. Merriam in Pahrump Valley at Yount's Ranch, April 28–29; at Mountain Spring in the Charleston Mountains, and at Upper Cottonwood Springs at the east base of these mountains, April 30. In Utah a few were observed still lingering in the Santa Clara Valley, May 11–15, though the bulk of the species had gone into the mountains before this date.

In California Mr. Nelson saw a few migrants the last of May among the piñons at the head of Willow Creek in the Panamint Mountains, though none were seen later by him in these or in the Grapevine Mountains. The same observer saw a few in the Inyo Mountains from the upper edge of the piñon belt to the summit of the range, June 24 to July 4, and sparingly in the White Mountains a little later. It was common at the head of Owens River, from 2,500 to 2,900 meters (8,200 to 9,500 feet) altitude, and also on the west slope in the Yosemite Valley and on the head of the Merced River. In Owens Valley it was observed at Lone Pine in December, 1890, and at Little Owens Lake, May 6–11.

Along the east slope of the Sierra Nevada it was seen at Independence Creek, where it was probably breeding, June 18–21; at Bishop Creek August 4–10; at Menache Meadows May 24–26; and at Big Cottonwood Meadows during the summer and early fall.

It was common at Horse Corral Meadows August 10, and along the Kaweah River, where it was breeding, from 2,130 meters (7,000 feet) altitude up to timber line during the first part of August. Mr. Palmer found it rather common on the summit of Frazier Mountain, near Old Fort Tejon, on July 9. Mr. Nelson found it common at San Luis Obispo, Santa Paula, Carpenteria, and in the San Joaquin Valley in November and December, 1891.

Record of specimens collected of Dendroica auduboni.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
2	♀ im.	San Bernardino, Calif.	Dec. 28, 1890	A. K. Fisher	
96	♂	Death Valley, Calif.	Feb. 1, 1891	do	Furnace Creek.
2	♂	Sierra Nevada, Calif.	June 19, 1891	B. H. Dutcher	Big Cottonwood Meadows.
3	♂	do	do	do	do
12	♀	do	July 7, 1891	do	do
142	♂	do	July 26, 1891	F. Stephens	

Dendroica nigrescens. Black-throated Gray Warbler.

The black-throated gray warbler was first observed among the piñons above Maturango Spring, in the Argus Range, California, where a female was secured May 8, containing a large egg in the oviduct, and on the following day one was seen carrying nesting material in its beak. Mr. Nelson saw a few in the Panamint Mountains among the piñons on Willow Creek the last of May, and found them breeding among the same trees in the Grapevine Mountains. Above the 'charcoal kilns' in Wild Rose Cañon in the Panamint Mountains, males were heard singing by Mr. Bailey and the writer June 25. This warbler was found breeding in the Inyo and White Mountains and in the Sierra Nevada, at the head of Owens River. Dr. Merriam shot one at Sheep Spring in the Juniper Mountains, Nevada, May 19, and two in the nut pines on Mt. Magruder, June 5. Mr. Bailey saw a few among the pines on the Kaweah River the last of July, and the writer saw one on the Hockett trail near Little Cottonwood Creek, August 23, and secured a specimen at Three Rivers, September 14.

Mr. Nelson reported a few as seen along the coast from San Simeon to Carpenteria, Calif., November 4 to December 18.

Record of specimens collected of Dendroica nigrescens.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Argus Range, Calif	May 9, 1891	T. S. Palmer	Maturango Spring.
	♀	do	do	do	Do.
211	♂	do	May 8, 1891	A. K. Fisher	Do.
212	♀	do	do	do	Do.
228	♀	do	May 13, 1891	do	Do.
229	♀	do	do	do	Do.
435	♀	Three Rivers, Calif	Sept. 14, 1891	do	
132	♀	Queen mine, Nev	July 11, 1891	F. Stephens	White Mountains.
	♂	Juniper Mountains, Nev	May 19, 1891	C. Hart Merriam	
	♂	Mount Magruder, Nev	June 5, 1891	V Bailey	
	♀	do	do	C. Hart Merriam	

Dendroica townsendi. Townsend's Warbler.

Townsend's warbler was first noted on the ridge above Maturango Spring in the Argus Range, California, where a male in full song was secured, and others seen among the piñons May 6. From this date until the departure of the party, May 15, the species was not uncommon, though there was no evidence of its intention to remain and breed, as in the case of the black-throated gray warbler. One was seen at Coso on May 19, and Mr. Stephens saw a small flock migrating among the creosote bushes northeast of Little Owens Lake, the second week in May.

In the Sierra Nevada Mr. Nelson saw two or three on the South Fork of the Merced River August 9. They were in company with a large number of other small birds of several species, gleaning insects from among the lower branches as they passed from tree to tree. On the coast Mr. Bailey found it common at Monterey September 28 to October 9, and Mr. Nelson saw it, though very sparingly, at Morro Bay and southward.

Record of specimens collected of Dendroica townsendi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
209	♂	Argus Range, Calif	May 6, 1891	A. K. Fisher	Maturango Spring.
219	♀	do	May 9, 1891	do	Do.
226	♂	do	May 11, 1891	do	Do.
	♀	Monterey, Calif	Oct. 5, 1891	V. Bailey	
	♀	Morro	Nov. 8, 1891	E. W. Nelson	

Dendroica occidentalis. Hermit Warbler.

This rare warbler was first seen among the piñons in the Argus Range, above Maturango Spring, where a pair was observed and a female secured May 6. The following day another was seen. Mr. Nelson saw a few among a migrating flock on the South Fork of the Merced, near Wawona, August 9. Mr. Palmer saw one in a mixed flock of warblers at Halsted Meadows, in the Sequoia National Park, August 7, and the writer secured a specimen at Horse Corral Meadows August 13. Mr. Belding saw migrants at Crocker's, 21 miles northwest of Yosemite Valley, in May.

Record of specimens collected of Dendroica occidentalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
109	♀	Argus Range, Calif.	May 6, 1891	A. K. Fisher	Maturango Spring.
415	♀ im.	Sierra Nevada, Calif.	Aug. 13, 1891	....do	Horse Corral Meadows.

Seiurus noveboracensis notabilis. Grinnell's Water-Thrush.

The only individual of this species obtained by the expedition was an adult male secured by Dr. Merriam and Mr. Bailey at the eastern edge of the Santa Clara settlement, in the Lower Santa Clara Valley, Utah, May 11, 1891.

Geothlypis macgillivrayi. Macgillivray's Warbler.

This warbler was first observed in Shepherd Cañon in the Argus Range, California, April 27, and afterwards at Maturango Spring, where it was common among the willow thickets. At Coso, the species was common in the shrubbery about the springs and along the cañons to the summit of the range, the latter part of May. Mr. Nelson found it a rather common migrant along the upper part of Willow and Mill Creeks in the Panamint Mountains during the last week of May. After this date comparatively few were seen, and these only within the sage belt along the willow-grown banks of springs and streams. A few were seen also in Wood Cañon in the Grapevine Mountains. In the Sierra Nevada, Mr. Nelson found it at the head of Owens River, though not common. Mr. Stephens saw a female accompanied by young at Bishop Creek, August 4–10; Mr. Dutcher secured specimens at Big Cottonwood Meadows, where the writer saw it August 26; and several were seen in the Sequoia National Park during the first week in August.

In Nevada Dr. Merriam found Macgillivray's Warbler common in Pahranagat Valley, May 22–26, immediately after a severe snowstorm, and thought it did not breed in the valley. He saw a single individual on Mount Magruder, Nevada, June 8, and Mr. Nelson found a few at the heads of streams on the east slope of the White Mountains.

Record of specimens collected of Geothlypis macgillivrayi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
218	♀	Argus Mountains, Calif.	May 9, 1891	A. K. Fisher	Maturango Spring.
254	♂	Coso, Coso Mountains, Calif.	May 24, 1891	....do	
255	♂	......do	May 25, 1891	....do	
267	♀	......do	May 28, 1891	....do	

Geothlypis trichas occidentalis. Western Yellow-throat.

The western yellow-throat was common in only a few localities visited by the expedition. At San Bernardino, Calif., it was tolerably common along the streams and in the thickets, December 28-29, 1890. It was seen in Surprise Cañon in the Panamint Mountains, April 16, and was not uncommon at Hot Springs in Panamint Valley, April 20–25. Mr. Nelson found a few during the latter part of May in the willows on Mill and Willow creeks in the Panamint Mountains, but observed none in the Grapevine Mountains. He saw a few at Hunter Cañon on the east slope of the Inyo Mountains, and also among some willows in Saline Valley. In Owens Valley it was a tolerably common summer resident from Little Owens Lake up to the head of the valley at the base of the White Mountains. In Death Valley the species was not uncommon in Furnace Creek Cañon and at Bennett Wells, June 19–21.

In Nevada, Dr. Merriam found it tolerably common and breeding in Pahranagat Valley, and saw it at Vegas Ranch, May 1, and along the Lower Santa Clara in Utah, May 11–15.

It was common along the South Fork of the Kern River, California, July 3–10; at Kernville, July 11–13; in Walker Basin, July 13–16, and at Bakersfield in the San Joaquin Valley, July 17–20.

On the coast of California Mr. Nelson found it, though in limited numbers, at the head of Morro Bay, and thence southward.

Record of specimens collected of Geothlypis trichas occidentalis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
8	♀ im.	San Bernardino, Calif.	Dec. 28, 1890	A. K. Fisher	
174	♂	Panamint Valley, Calif	Apr. 21, 1891	....do	Hot Springs.
320	♂	Death Valley, Calif.	June 21, 1891	....do	Furnace Creek.
78	♂	Owens Valley, Calif	June 9, 1891	F. Stephens	Olancha.
82	♀	....do	June 10, 1891	....do	

Icteria virens longicauda. Long-tailed Chat.

Owing to the lack of suitable localities for nesting the yellow-breasted chat was found sparingly in most of the region traversed by the expedition. It was moderately common in Owens Valley, at Lone Pine, June 4–15, and Mr. Stephens found it in the same valley, though not commonly, at Olancha, May 16–23; at Ash Creek, May 30–June 3; at Independence Creek, June 18–23, and at Morans, July 4–7. Mr. Nelson saw and heard one, which sang in the evening and the greater part of the night of May 22, near his camp on Willow Creek in the Panamint Mountains, and observed others in the Inyo Mountains, from Hunter's arastra down to the bottom of Saline Valley, during the latter part of June. At Furnace Creek, Death Valley, chats were tolerably common at the ranch and in the cañon above it, June 19–21. At Kernville, Calif., and along Kern Valley, chats were common June 22–23, and

July 11–13; in Walker Basin, July 13–16, and several were seen in the Cañada de las Uvas June 28, 29. At Bakersfield, in the San Joaquin Valley, it was seen or heard every day from July 17–20.

In Nevada, Dr. Merriam found it in the lower part of Vegas Wash, May 3; at the Bend of the Colorado, May 4; in the valleys of the Virgin and Muddy, May 6–8; and in Pahranagat Valley, as a common breeder, May 22–26. In the Santa Clara Valley, Utah, it was a tolerably common breeder, May 11–15.

Record of specimens collected of Icteria virens longicauda.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
294	♂	Owens Valley, Calif.	June 5, 1891	A. K. Fisher	Lone Pine.
349	♂	Death Valley, Calif	June 21, 1891	....do	Furnace Creek.

Sylvania pusilla pileolata. Pileolated Warbler.

The black-capped warbler was first seen in Surprise Cañon in the Panamint Mountains, April 17, and Mr. Nelson found it rather common among the willows at the head of Willow, Mill, and Cottonwood creeks in the same mountains the last of May, after which time he did not see it there. A few were seen in the Argus Range in Shepherd Cañon, April 27, and the species was common about Maturango Spring, in the willows and rosebushes during the first half of May. It was seen in the Coso Mountains in the bottom of the cañons among the shrubbery, the last of May, and at the head of the streams in the White Mountains, in July. Mr. Stephens found it migrating in Salt Wells Valley, May 1–5; at Little Owens Lake, May 6–11; at Olancha, May 16–23; and in Reche Cañon, September 22–24. In the High Sierra it was seen in the Sequoia National Park the first week in August; at Horse Corral Meadows, August 9–13; at the head of Owens River and on the western slope opposite, in July and August; at Big Cottonwood Meadows, during the summer; at Round Valley, 12 miles south of Mount Whitney, the last of August; and north of Mineral King, September 10–11.

In Nevada, Dr. Merriam saw it at a large spring in Pahrump Valley, April 29; at Mountain Spring in the Charleston Mountains, April 30; at Upper Cottonwood Springs at the east base of these mountains, the same day; at Vegas ranch, May 1; at the Bend of the Colorado, May 4; and in the Valley of the Virgin and Lower Muddy, May 6.

Record of specimens collected of Sylvania pusilla pileolata.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
190	♂	Argus Range, Calif.	Apr. 27, 1891	A. K. Fisher	Shepherd Cañon.
223	♀	......do	May 10, 1891	....do	Maturango Springs.
13	♂	Sierra Nevada, Calif.	July 7, 1891	B. H. Dutcher	Big Cottonwood Meadows.

Anthus pensilvanicus. Titlark.

The titlark was found as a winter resident in suitable localities in southern California and Nevada.

In California Mr. Nelson saw a few at Lone Pine, and found it very common along the shore of Owens Lake in December, 1890; he also saw a few at Hot Springs, Panamint Valley, in the early part of January, where the writer secured a specimen, April 22, 1891. At San Bernardino several flocks were seen in a wet meadow bordering a stream, on December 28, 1890. In Death Valley a flock of twenty or more was always to be found in the alfalfa fields at Furnace Creek, and a few were observed at Saratoga Springs during the latter part of January. Dr. Merriam saw two in the Mohave Desert on the sand beach bordering the Mohave River at Victor, March 30. At various places in the San Joaquin Valley Mr. Nelson found it congregated in small flocks in October, and common in fields and along the coast from San Simeon to Carpenteria, in November and December.

In Nevada the species was common at Ash Meadows in flocks on the wet marshes and plowed fields during the first three weeks of March, and Mr. Nelson found it not uncommon about wet ground in both Vegas and Pahrump valleys, and near the upper end of Vegas Wash about the same time.

Record of specimens collected of Anthus pensilvanicus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
6	♂	San Bernardino, Calif	Dec. 28, 1890	A. K. Fisher	
89	♀	Death Valley, Calif	Jan. 30, 1891	do	Furnace Creek.
90	♀	do	do	do	Do.
182	♀	Panamint Valley, Calif	Apr. 23, 1891	do	Hot Springs.

Cinclus mexicanus. Water Ousel.

The dipper or water ousel was seen only along the streams of the Sierra Nevada, in California. In December, 1890, Mr. Nelson saw one on Owens River at the mouth of Lone Pine Creek. The writer first observed the species on the South Fork of Kern River, where a specimen was secured July 7 as it was flying from boulder to boulder in a rapid portion of the stream. It was seen at Horse Corral Meadows August 9–13, and was common in Kings River Cañon August 13–16. At the latter place an old nest was discovered in the eroded end of a drift log which hung out over a waterfall. The dipper was met with by Mr. Nelson at the head of Owens River and in the Yosemite Valley, and by Mr. Stephens at Bishop Creek. It was common in the high mountains along the streams in Big Cottonwood and Whitney Meadows, where specimens were secured. Mr. Palmer observed one at an altitude of about 3,500 meters (11,600 feet) in Langley Meadow September 10.

Record of specimens collected of Cinclus mexicanus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
381	im.	Kern River, Calif	July 7, 1891	A. K. Fisher	South Fork
433	♂	Whitney Meadows, Calif	Aug. 31, 1891	...do	
15	♂	Sierra Nevada, Calif	July 8, 1891	B. H. Dutcher	Big Cottonwood Meadows.
24	♂	...do	Aug. 2, 1891	...do	Do.
416	♂	Kings River Cañon, Calif	Aug. 14, 1891	A. K. Fisher	

Oroscoptes montanus. Sage Thrasher.

The sage thrasher is a characteristic inhabitant of the sage plains, occurring in company with the sage sparrow (*Amphispiza belli nevadensis*), Brewer's sparrow (*Spizella breweri*), and the lark sparrow (*Chondestes grammacus strigatus*). It was not found in the lower valleys except as a winter resident. A flock of six or eight was seen at Hesperia in the Mohave Desert, January 4, and about an equal number at Granite Wells, January 13–15. One was observed at Mesquite Well in Death Valley, January 20. Mr. Nelson saw about half a dozen in the sage brush on the divide between Willow and Cottonwood creeks in the Panamint Mountains, where they seemed to be breeding during the last of May. Dr. Merriam found the species common among the sage brush north of Telescope Peak April 15. A pair was observed in Coso Valley, below Maturango Spring, May 11, and Mr. Nelson reported the species common in the same place in January.

In Nevada a few were noted at Ash Meadows in March, and Mr. Nelson found them in both Pahrump and Vegas valleys. Dr. Merriam found them common in the sage brush on the rolling plateau of the Juniper Mountains, May 18; in the valley between Gold Mountain and Mount Magruder, June 4; and on Mount Magruder plateau, June 5–8, where a nest containing two fresh eggs was found in a sage bush, June 8. In the Santa Clara Valley in southwestern Utah, they were not found near St. George, but were seen first on May 15, about 8 miles northwest of that place where the sage brush begins. A few miles further north, at the upper Santa Clara Crossing, they were one of the most abundant birds, May 17; and at Mountain Meadows, Utah, where they were common, he shot an adult male sitting on a nest containing four fresh eggs, May 17. Mr. Nelson found them sparingly among the piñons in the Inyo Mountains, California, the latter part of June; saw a few on the White Mountains and found them rather common about the head of Owens Valley, in July. He reported them as common up to 2,450 meters (8,000 feet), at the head of Owens River. Mr. Stephens saw several at Morans, July 4–7; found them common at Benton, July 9–10; and at Queen mine, in the White Mountains, Nevada, where a few were heard singing, July 11–16.

Record of specimens collected of Oroscoptes montanus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
34	♂	Hesperia, Calif	Jan. 4, 1891	A. K. Fisher	
51	♂	Granite Wells, Calif	Jan. 14, 1891	....do	
60	♂	......do	....do	....do	
		Coso Valley, Calif	May 12, 1891	T. S. Palmer	
45	♂	Panamint Mountains, Calif	Apr. 15, 1891	F. Stephens	
130	♂	Owens Valley, Calif	July 9, 1891	....do	Benton.
30	♂	Ash Meadows, Nev	Mar. 11, 1891	....do	
	♂	St. George, Utah	May 16, 1891	V. Bailey	3,800 feet altitude.
	♂	Mountain Meadows, Utah	May 17, 1891	C. Hart Merriam	Nest and eggs.

Mimus polyglottos. Mocking Bird.

The mocking bird was found sparingly in the desert regions of California, and was more or less common in similar localities in Nevada, Utah, and Arizona. It was common about San Bernardino, Calif., and in Cajon Pass the first of January and the latter part of March. In Death Valley, one was seen at Saratoga Springs in the latter part of January, and others in various other parts of the valley proper and in the northwest arm (Mesquite Valley), April 8–13, but was not seen anywhere in the valley during the trip of June 19–21. It was found at Hot Springs in Panamint Valley, April 20–24, and was tolerably common among the yuccas in Coso Valley and Mountains, throughout May. Mr. Nelson found it through the north end of the Panamint Mountains from the divide between Cottonwood and Willow creeks down to the botton of Mesquite and Saline valleys. In the Grapevine Mountains it ranged up to the base of the main summits, at an altitude of 2,450 meters (8,000 feet). The same observer found it common as high as the lower edge of the piñons in the Inyo Mountains, to 2,370 meters (7,800 feet) at the head of Owens River in the Sierra, and a few from the head of Owens Valley up to 2,430 meters (8,000 feet) in the White Mountains.

In Nevada, Dr. Merriam found Mocking Birds in Tule Cañon, at the extreme northern end of the northwest arm of Death Valley, June 4; on the southern slope of Gold Mountain, among the tree yuccas, June 3; in Oasis Valley, June 1; in the Timpahute Mountains, May 26 (among the tree yuccas); in Pahranagat Valley, May 22–26 (common and breeding); at Pahroc Spring, May 20–22; in Meadow Creek Valley, May 19; in the valleys of the Muddy and Virgin, May 6–8 (common); at the Bend of the Colorado May 4; in Vegas Valley and Wash, April 30–May 3; and in Pahrump Valley, April 28–29 (several in the tree yuccas on east side of valley). In Utah, he found them common in the Lower Santa Clara Valley, May 11–15, and abundant on both sides of the Beaverdam Mountains, May 10–11.

They were tolerably common in Owens Valley, Calif., where they were seen at Little Owens Lake, Keeler, and Lone Pine. A pair was seen on the eastern slope of Walker Pass, July 1, and another at Walker Basin, July 15; they were common at Bakersfield, July 17–20; in Tehachapi Pass, June 25, and a few were observed around Visalia in July. Several were seen in Reche Cañon, by Mr Stephens, September 22–24; and a male by Mr. Nelson at Santa Paula, during the last of December.

Harporhynchus redivivus. California Thrasher.

The California thrasher is a bird of the chaparral and was not found in the desert regions east of the Sierra Nevada. At San Bernardino the writer saw one December 29, 1890, and Mr. Stephens reported the species rather common in Reche Cañon near the same place, September 22–24, 1891. A pair was seen at Cane Brake ranch on the western slope of Walker Pass, July 3, and several at Kernville, where two were secured July 12. A number were seen in Walker Basin, July 13–16, and Dr. Merriam found the species common between that place and Caliente June 24; in the Cañada de las Uvas June 28–29; and in the Sierra Liebre June 30. In the latter range it passes over the divide and occurs in the chaparral on the north slope, close to the edge of the Mohave Desert. Several were seen at Bakersfield, in the San Joaquin Valley, July 17–20. Mr. Bailey saw a pair in the oak brush just below the edge of the conifers on the Kaweah River, and others at Boulder Creek; and Mr. Nelson found them common along the coast, from Morro to Santa Paula, during November and December.

Record of specimens collected of Harporhynchus redivivus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
386	♀ im.	Kernville, Calif	July 11, 1891	A. K. Fisher	
	♀	do	do	V. Bailey	
165	♂	Hesperia, Calif	Sept. 15, 1891	F. Stephens	

Harporhynchus lecontei. LeConte's Thrasher.

Le Conte's thrasher is a characteristic bird of the deserts of southeastern California and southern Nevada and Arizona, where it was found in all the Lower Sonoran valleys east of the Sierra visited by the expedition. It is not a migratory species and probably remains in the vicinity of its summer home the entire year. This statement is strengthened by the fact that in most places where the species was found old nests were also observed. These were placed in arborescent cactuses, mesquite, or other thorny shrubs.

This thrasher was first seen by us not far from Victor, in the Mohave Desert, California, January 7, and a number were noticed between Daggett and Granite Wells, January 8–13 and April 4–6. In Death Valley, a pair was seen at Bennett Wells January 21, others about the middle of April, and a pair with five young on June 21; at Furnace Creek one was seen the last ot January. At Resting Springs the species was very common among the mesquite, where the males were frequently heard singing from their perches on the uppermost branches, February 6–17.

In Nevada it was common at Ash Meadows in March, and Mr. Nelson found it in Pahrump Valley, at the western base of the Charleston Mountains. East of Pahrump Valley Dr. Merriam saw several April 29, and a full-grown young was shot among the yuccas. He killed one in Vegas Valley May 1, and found the species tolerably common in the valley of the Virgin and Lower Muddy. A nest was found in a branching cactus (*Opuntia echinocarpa*) on the mesa between these rivers, and, although the parent bird was on the nest, no eggs had been laid. In southwestern Utah it was found on the west side of the Beaverdam Mountains almost to the summit of the range, keeping in the tree yuccas and arborescent cactuses with the cactus wren.

At Hot Springs, in Panamint Valley, California, it was seen the last of April, and in Coso Valley and Mountains through May. It is common in Owens Valley, from Little Owens Lake, where Mr. Stephens found a nest and three eggs and a brood of nearly grown young, to Benton, where both he and Mr. Nelson saw it. Mr. Stephens found it common in Salt Wells Valley, where nests and young were observed. In Walker Pass it was common among the tree yuccas on the east side, and Dr. Merriam saw several on the west slope, about 4 miles from the summit, June 22–23. He found it common throughout the western tongue of the Mohave Desert, where a nest containing two half-grown young was found in a branching cactus (*Opuntia echinocarpa*) June 27.

In the San Joaquin Valley Mr. Nelson found it common about the southern and western sides of Buena Vista Lake, and thence west and northwest for 15 to 18 miles toward the base of the Temploa Mountains. This was the actual range in which he noted the species, though it undoubtedly occupied much more territory in the vicinity, where the low growth of desert bushes and sandy arroyos near the lake formed a congenial home.

LeConte's thrasher is a sly, skulking species, quite difficult to collect, and when running about among the desert shrubbery closely resembles the road-runner in form and actions.

The song of this species like that of the other members of the genus is sweet and variable, and in many respects rivals that of the mockingbird in musical elegance. In many places throughout its range the young (just before they leave the nest) are regularly hunted by both whites and Indians for the purpose of making cage birds of them.

At Keeler, in Owens Valley, Mr. H. E. Wilkinson, meteorological observer, had one which was allowed the freedom of the house. It was very tame and would allow itself to be caught and placed in the cage for the night. One of its favorite amusements was to sit on the window sill and catch the flies which were moving on the panes.

Record of specimens collected of Harporhynchus lecontei.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
19	♂	Resting Springs, Calif	Feb. 14, 1891	F. Stephens	
20	♂	do	do	do	
23	♂	Twelve-mile Spring, Calif	Feb. 20, 1891	do	North of Resting Springs.
	♂	Ash Meadows, Nev	Mar. 19, 1891	E. W. Nelson	
121	♂	do	Mar. 10, 1891	A. K. Fisher	
133	♂	do	Mar. 19, 1891	do	
	♂	Pahrump Valley, Nev	Feb. 11, 1891	E. W. Nelson	
	♀	do	do	do	
	♂ juv.	do	Apr. 29, 1891	C. Hart Merriam	
	♀ im.	Vegas Valley, Nev	May 1, 1891	do	
	♂	Beaverdam Mountains, Utah.	May 10, 1891	do	
29	♂	Table Mountain, Nev	May 6, 1891	F. Stephens	Amargosa Desert.
	♂	Buena Vista Lake, Calif	Oct. 26, 1891	E. W. Nelson	San Joaquin Valley.
164	♀	Hesperia, Calif	Sept. 15, 1891	F. Stephens	
53	♂	Salt Wells Valley, Calif	May 4, 1891	do	
284	♂ im.	Owens Valley, Calif	June 2, 1891	A. K. Fisher	Keeler.
	♀	do	Dec. 27, 1890	E. W. Nelson	Lone Pine.
126	♂ im.	do	July 3, 1891	F. Stephens	22 miles north of Bishop.
	♀	Coso Mountains	Dec. 31, 1890	E. W. Nelson	
	♂	do	do	V. Bailey	
	♂	Panamint Valley, Calif	Jan. 10, 1891	do	
44	♂	Daggett, Calif	Jan. 7, 1891	A. K. Fisher	
	♂ juv.	Mohave Desert, Calif	June 27, 1891	T. S. Palmer	Willow Spring.
	♂ juv.	do	do	do	Do.
	♀ im.	Death Valley, Calif	June 21, 1891	V. Bailey	Bennett Wells.
	♂	do	Jan. 30, 1891	E. W. Nelson	Saratoga Springs.
17	♀	Garlick Springs, Calif	Feb. 10, 1891	F. Stephens	
16	♀	do	do	do	
99	♀	Resting Springs, Calif	Feb. 7, 1891	A. K. Fisher	
100	♀	do	do	do	
101	♂	do	do	do	
107	♀	do	Feb. 11, 1891	do	

Harporhynchus crissalis. Crissal Thrasher.

The crissal thrasher was not found in the Mohave or Amargosa deserts, nor in Death, Panamint, or other valleys west of the Charleston Mountains, where LeConte's thrasher is so common. Dr. Merriam found it from Vegas Valley, Nevada, eastward. He observed it in the valley of the Virgin, near St. Joe, Nev., May 7, and near Bunkerville, May 8; and found it a common breeder in the Lower Santa Clara Valley, Utah, where a nest containing two fresh eggs was discovered in a bush of *Atriplex torreyi*, about 3 feet above the ground, May 16. Mr. Nelson also found a nest containing three eggs, at Cottonwood Spring, at the east base of the Charleston Mountains, March 8. The bird was shot from the nest, which was placed partly on one of the large branches of a desert willow (*Chilopsis saligna*) and partly on top of an *Atriplex canescens* bush growing under it. The structure was formed externally of coarse twigs, a few inches long, and lined with hemp-like strips of bark from a plant growing in the vicinity.

Heleodytes brunneicapillus. Cactus Wren.

The cactus wren is an abundant and characteristic bird of the Lower Sonoran Zone, breeding wherever there are suitable forests of tree yuccas or arborescent cactuses, and sometimes in other forms of spiny vegetation, as the desert acacia (*Acacia greggii*). It was first seen in the Mohave Desert, at Hesperia, a few miles from the summit of Cajon Pass, where the males were singing from the tops of the tree yuccas, January 4–5. Mr. Stephens found a nest containing four fresh eggs in a 'cholla' (cactus) in Salt Wells Valley, about 8 miles north of Indian Wells, the 1st of May, and saw the species sparingly in Owens Valley, a few miles north of Little Owens Lake. In the Coso Valley, and at Coso in the mountains of the same name, Mr. Palmer and the writer found this species among the tree yuccas, and the former observer found a number of old nests during the first half of May. In the early part of July, the species was very common in Walker Pass, where as many as half a dozen were seen in one yucca, and at the South Fork of the Kern River it was found to be common wherever yuccas occurred. Mr. Nelson found it rather common about the ranch in Vegas Valley, Nevada, and still more numerous among the mesquite in Vegas Wash near the Colorado River, where the birds were in full song, March 10.

Dr. Merriam furnished the following notes on this species: "In the Mohave Desert, California, many nests were found in tree yuccas between Cajon Pass and Pilot Knob, the first week in April, but none of them contained eggs. The species reaches the extreme western end of the desert (Antelope Valley), and a few were seen in yuccas and sage-brush in a wash leading south from Gorman ranch toward Peru Creek, June 30.

"From the Mohave Desert the cactus wren extends up the wash leading to Tehachapi Basin, where it was tolerably common in the yuccas and 'chollas' below Cameron. In Walker Pass, it ranges from the east or Mohave Desert side completely across the Sierra to the valley of Kern River, where it is abundant in groves of tree yuccas and in 'chollas' down to 820 meters (2,700 feet) altitude, and where dozens of their large nests were seen in the cactuses, June 22. In Nevada two nests were found in *Acacia greggii* at Bitter Springs in the Muddy Mountains, May 5; both had been used the present season, and one contained an addled egg. The species was common on the high mesa between the Muddy and Virgin rivers, May 7, where nearly every branching cactus contained the remnants of a nest, but all the young had hatched and flown away. In the Beaverdam Mountains, in southwestern Utah, they were common in yuccas and cactuses up to 1,150 meters (3,800 feet) on the west slope. In the Lower Santa Clara Valley, Utah, near St. George, they were common, breeding in the arborescent cactus, May 11–15. This valley is the extreme northeastern limit of distribution of the species. In Southern California, on the coast slope, it is abundant on the San Bernardino Plain, and thence southward. Many were seen in the Santa Clara Valley at its junction with Castac Creek, June 30, where its nests were conspicuous in the tall cactus (*Opuntia bernardina*)."

Record of specimens collected of Catherpes mexicanus conspersus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint, Calif	Jan. 10, 1891	V. Bailey	
	♂	Panamint Mountains, Calif	Mar. 30, 1891	E. W. Nelson	Johnson Cañon.
	♀	do	Mar. 28, 1891	do	Do.
143	♂	do	do	A. K. Fisher	Do.
156	♀	do	Apr. 13, 1891	do	Surprise Cañon.
157	♂	do	do	do	Do.
165	♂	do	Apr. 18, 1891	do	Do.

Thryothorus bewickii spilurus. Vigors's Wren.

A specimen taken at San Bernardino, December 29, 1890, although not typical of this race, resembles it more closely than it does any other. The bird which Mr. Bailey saw commonly at Monterey was undoubtedly this subspecies. Mr. Nelson found a form of Bewick's wren which probably belongs to this race common at San Luis Obispo, the last of October, in the Tejon and Temploa mountains about the same time, and along the route from San Simon to Carpenteria and Santa Paula during November and December.

Thryothorus bewickii bairdi. Baird's Wren.

The white-throated wren was more or less common in various places visited by the expedition. One was seen among the tree yuccas at Hesperia, in the Mohave Desert, January 4. In Death Valley a specimen was secured at Furnace Creek January 31, and a few individuals were seen among the mesquite thickets at Bennett Wells, and between that place and Saratoga Springs, about the same time. A few were seen at Resting Springs in the Amargosa Desert, in February.

In the Panamint Mountains it was seen in Johnson Cañon, early in April; by Dr. Merriam in Emigrant Cañon, April 14–15; on the north side of Telescope Peak, April 17–19, and by Mr. Nelson in Surprise Cañon, in January. In the Argus Range a few were seen in Shepherd Cañon in January, and a specimen was secured at Maturango Spring May 13. In the Coso Mountains a family in which the young were full grown and able to fly was seen in one of the cañons, May 23. Dr. Merriam saw many on the summit of the White Mountains, between Deep Spring and Owens valleys, where young were following their parents about among the piñon and juniper, June 9. Mr. Nelson found it common at Lone Pine in December, 1890, and two or three were seen in Walker Pass, July 2–3. The species was common along the South Fork of Kern River to Kernville, July 3–13, and Mr. Palmer saw one in Kings River Cañon in August. Mr. Stephens saw it at the Queen mine in the White Mountains, Nevada, July 11–16.

In Nevada, several were seen at Ash Meadows, Pahrump and Vegas valleys, and in the Grapevine Mountains, in March. In the Santa Clara Valley, Utah, one was shot and several others seen, May 11–16, and an old nest was found in a hole in a cottonwood, about 3 feet above the ground.

Record of specimens collected of Thryothorus bewickii bairdi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
12	♀	San Bernardino, Calif.	Dec. 29, 1890	A. K. Fisher	Resembling closely *spilurus*.
94	♂	Death Valley, Calif.	Jan. 31, 1891	do	Furnace Creek.
299	♂	Argus Range, Calif.	May 13, 1891	do	Maturango Spring.
21	♂	Resting Springs, Calif.	Feb. 17, 1891	F. Stephens	
	♂	White Mountains, Calif.	June 9, 1891	V. Bailey	
	♀ juv.	do	do	do	
	♂	Santa Clara, Utah	May 11, 1891	C. Hart Merriam	

Troglodytes aëdon aztecus. Western House Wren.

The western house wren was not seen in many localities, though when found it was not an uncommon species. A few were seen at Ash Meadows, Nev., about March 20. Specimens taken at San Bernardino, Calif., in the latter part of December, 1890, were intermediate between this race and Parkman's wren of the northwest coast region. In the Panamint Mountains it was first observed in Johnson Cañon, April 12, in Suprise Cañon a little later, and in Emigrant Cañon April 14–15. A few were seen in an alfalfa field at Grapevine Spring, on the western slope of the Grapevine Mountains, the first week in April, and in Shepherd Cañon, in the Argus Range, the last week of the month. Mr. Stephens found it rather common at Searl's garden, near the south end of the same range, April 23–26; at Bishop Creek, in Owens Valley, August 4–10, and among the brush on the side of Reche Cañon, September 22–24. Several were seen along the South Fork of Kern River, July 3–10, and among the oaks above Walker Basin, July 14. Mr. Palmer found the house wren abundant at Old Fort Tejon early in July, and Mr. Nelson saw several in the Cañada de las Uvas and along San Emigdio Creek about the middle of October. In the High Sierra, Mr. Nelson saw it at the head of Owens River, and on the west slope down into the Yosemite Valley. It was common in the Sequoia National Park during the first week in August; at Horse Corral Meadows, August 9–13; near timber line in Round Valley, 12 miles south of Mount Whitney, August 28; Mineral King, September 9–10; and at Three Rivers, in the western foothills of the Sierra, September 14.

Record of specimens collected of Troglodytes aëdon aztecus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
3	♂	San Bernardino, Calif.	Dec. 28, 1890	A. K. Fisher	Inclining toward *parkmanii*.
4	♀	do	do	do	Do.
	♂	Panamint Mountains, Calif.	Apr. 11, 1891	E. W. Nelson	Johnson Cañon.
	♂	Kern River, Calif.	July 4, 1891	V. Bailey	South Fork.
	♂	Sierra Nevada, Calif.	July 20, 1891	E. W. Nelson	San Joaquin River.
139	♂ im.	do	July 22, 1891	F. Stephens	
155	♀ im.	do	Aug. 21, 1891	do	Olancha Peak.
624	♀	do	Aug. 27, 1891	A. K. Fisher	Round Valley, 12 miles south Mount Whitney.

Record of specimens collected of Catherpes mexicanus conspersus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Panamint, Calif	Jan. 10, 1891	V. Bailey	
	♂	Panamint Mountains, Calif	Mar. 30, 1891	E. W. Nelson	Johnson Cañon.
	♀	......do	Mar. 28, 1891	....do	Do.
143	♂	......do	....do	A. K. Fisher	Do.
156	♀	......do	Apr. 13, 1891	....do	Surprise Cañon.
157	♂	......do	....do	....do	Do.
165	♂	......do	Apr. 18, 1891	....do	Do.

Thryothorus bewickii spilurus. Vigors's Wren.

A specimen taken at San Bernardino, December 29, 1890, although not typical of this race, resembles it more closely than it does any other. The bird which Mr. Bailey saw commonly at Monterey was undoubtedly this subspecies. Mr. Nelson found a form of Bewick's wren which probably belongs to this race common at San Luis Obispo, the last of October, in the Tejon and Temploa mountains about the same time, and along the route from San Simon to Carpenteria and Santa Paula during November and December.

Thryothorus bewickii bairdi. Baird's Wren.

The white-throated wren was more or less common in various places visited by the expedition. One was seen among the tree yuccas at Hesperia, in the Mohave Desert, January 4. In Death Valley a specimen was secured at Furnace Creek January 31, and a few individuals were seen among the mesquite thickets at Bennett Wells, and between that place and Saratoga Springs, about the same time. A few were seen at Resting Springs in the Amargosa Desert, in February.

In the Panamint Mountains it was seen in Johnson Cañon, early in April; by Dr. Merriam in Emigrant Cañon, April 14–15; on the north side of Telescope Peak, April 17–19, and by Mr. Nelson in Surprise Cañon, in January. In the Argus Range a few were seen in Shepherd Cañon in January, and a specimen was secured at Maturango Spring May 13. In the Coso Mountains a family in which the young were full grown and able to fly was seen in one of the cañons, May 23. Dr. Merriam saw many on the summit of the White Mountains, between Deep Spring and Owens valleys, where young were following their parents about among the piñon and juniper, June 9. Mr. Nelson found it common at Lone Pine in December, 1890, and two or three were seen in Walker Pass, July 2–3. The species was common along the South Fork of Kern River to Kernville, July 3–13, and Mr. Palmer saw one in Kings River Cañon in August. Mr. Stephens saw it at the Queen mine in the White Mountains, Nevada, July 11–16.

In Nevada, several were seen at Ash Meadows, Pahrump and Vegas valleys, and in the Grapevine Mountains, in March. In the Santa Clara Valley, Utah, one was shot and several others seen, May 11–16, and an old nest was found in a hole in a cottonwood, about 3 feet above the ground.

Fort Tejon the first week in July. The writer found it rather common in the Sequoia National Park during the first week in August, at Horse Corral Meadows August 9–13, in Kings River Cañon August 13–16, and in Round Valley, 12 miles south of Mount Whitney, and Whitney Meadows the last of the month. At Three Rivers, in the western foothills of the Sierra, it was common among the oaks July 25–30; Mr. Bailey saw it along the Kaweah River up to timber line in August; Mr. Dutcher found it a common summer resident at Big Cottonwood Meadows, and Mr. Stephens reported it as rather common at Menache Meadows May 24–26. Mr. Nelson saw it from the Cañada de las Uvas to the head of San Emigdio Cañon the last of October, and in the mountains near San Simeon in November.

Record of specimens collected of Sitta carolinensis aculeata.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
332	♂	Panamint Mountains, Calif.	June 23, 1891	A. K. Fisher	Telescope Peak.
427	♀	Sierra Nevada, Calif.	Aug. 27, 1891	...do	Round Valley, 12 miles south Mount Whitney.
20	♂	...do	July 30, 1891	B. H. Dutcher	Big Cottonwood Meadows.

Sitta canadensis. Red-bellied Nuthatch.

The red-bellied nuthatch was not seen in the mountain ranges east of the Sierra Nevada in California. It was common in the Sequoia National Park and Horse Corral Meadows, where it was often heard or seen during the first half of August. Mr. Nelson saw a few on the western slope of the mountains opposite the head of Owens River, and the writer found it common among the flocks of migrants in Round Valley, 12 miles south of Mount Whitney, August 27–28, and at timber line above Mineral King September 9–11. On the coast Mr. Bailey reported the red-bellied nuthatch as common at Monterey September 28 to October 9.

Record of specimens collected of Sitta canadensis.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
406	♀	Sierra Nevada, Calif.	Aug. 4, 1891	A. K. Fisher	Sequoia National Park.
431	♀	...do	Aug. 28, 1891	...do	Round Valley, 12 miles south Mount Whitney.

Sitta pygmæa. Pygmy Nuthatch.

The only locality east of the Sierra Nevada where this nuthatch was met with was the Charleston Mountains, Nevada, where Mr. Palmer and Mr. Nelson found it common in February high up among the fox-tail pine (*Pinus aristata*). Mr. Stephens found it not uncommon nearly

Cistothorus palustris paludicola. Tule Wren.

The long-billed marsh wren was common in a number of places where tules and other rank vegetation occurred along the streams, lakes, or marshes. In Death Valley a few were seen at Furnace Creek and Bennett Wells, and a considerable number at Saratoga Springs during the latter part of January. Dr. Merriam found it common at the latter place among the reeds April 26. In Owens Valley Mr. Nelson found it at Keeler and Lone Pine in December, 1890, and Mr. Stephens reported it common at Little Owens Lake May 6–11. In Nevada it was common in Pahrump, Vegas, and Oasis valleys, and not uncommon at Ash Meadows in March. Dr. Merriam also found it common in the valley of the Muddy May 6, in Pahranagat Valley May 23, breeding in the tules, and Mr. Stephens saw several at Grapevine spring April 1–4.

Record of specimens collected of Cistothorus palustris paludicola.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
93	♂	Death Valley, Calif.	Jan. 31, 1891	A. K. Fisher	Furnace Creek.
132	♀	Ash Meadows, Nev.	Mch. 18, 1891	do	

Certhia familiaris occidentalis. California Creeper.

The tree creeper was seen nowhere except in the High Sierra. Mr. Palmer and the writer saw it at the deserted Kaweah sawmill in the Sequoia National Park, and at other places in the same general region, the first week in August, and at Horse Corral Meadows a week later. Mr. Nelson found it at the head of Owens River and in the Yosemite Valley, and Mr. Dutcher at Big Cottonwood Meadows. The writer saw it at the latter place and also at Whitney Meadows and Soda Springs about the 1st of September. Mr. Nelson observed a few at Mount Piños in October.

Sitta carolinensis aculeata. Slender-billed Nuthatch.

In California the slender-billed nuthatch was seen among the pines on several of the mountain ranges and in the oaks west of the Sierra Nevada. In the Panamint Mountains it was not uncommon in Johnson and Surprise cañons among the piñons, where a pair was seen hunting for a nesting site April 20. Dr. Merriam saw several among the junipers on the north side of Telescope Peak April 17–19, and Mr. Bailey and the writer heard and saw it near the same place June 23–24. A pair was seen among the piñons above Maturango Spring May 13; Mr. Nelson found it at the head of Owens River, and on the western slope opposite, in July and August; and Mr. Stephens heard it near Queen station, Nev., July 11–16. Dr. Merriam saw one among the live oaks between Havilah and Walker Basin, June 24, one in Tehachapi Pass June 25, and Mr. Palmer reported the species as common at Old

March. In the Panamint Mountains, California, it was seen in Johnson and Surprise cañons among the piñons and junipers in April, and Dr. Merriam found it common north of Telescope Peak, where a female, containing eggs nearly ready to be deposited, was killed, April 17–19. The writer saw a few at the same place June 22. Mr. Nelson noted it sparingly among the piñons on the Panamint, Grapevine, Inyo, and White mountains during the breeding season. Along the eastern slope of the Sierra Nevada a few were seen at the head of Owens River, and at Benton, in July.

Record of specimens collected of Parus inornatus griseus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
47	♀	Panamint Mountains, Calif	Apr. 18, 1891	F. Stephens	
145	♂	do	Mar. 28, 1891	A. K. Fisher	Johnson Cañon.
146	♀	do	do	do	Do.
168	♀	do	Apr. 19, 1891	do	Surprise Cañon.
	♂	Charleston Mountains, Nev	Mar. 7, 1891	V. Bailey	

Parus gambeli. Mountain Chickadee.

The mountain chickadee was seen on all the mountains which support a growth of pines. In Nevada Mr. Palmer reported it common about the camp in the Charleston Mountains in February, and Mr. Stephens found a few in the Grapevine Mountains in March. Dr. Merriam found it breeding on Mount Magruder, high up among the nut pines, June 5–11, and Mr. Stephens saw several at the Queen mine in the White Mountains, July 11–16.

In the Panamint Mountains, California, it was tolerably common in Johnson and Surprise cañons in April. Dr. Merriam found it common near Telescope Peak about the middle of the month, though Mr. Nelson reported it as apparently rare among the piñons in the northern end of the range as well as in the Grapevine Mountains in June. At the 'charcoal kilns' near the head of Wild Rose Cañon, the writer noted it as quite common and found a nest with young June 24.

It was not uncommon in the Argus Range, where a nest containing eight fresh eggs was found in a piñon on the ridge above Maturango Spring, May 14. The nest, which was composed of fine grass and hair, was placed in an eroded cavity behind the end of one of the lower limbs which had been partially torn and twisted from the trunk by heavy snow or violent wind. It was perfectly concealed and would never have been discovered had the bird remained quiet when the writer accidentally struck the drooping branch. Mr. Nelson reported it as breeding sparingly from the lower edge of the piñons up to the summit in the Inyo Mountains and to timber line in the White Mountains. This chickadee was common at the head of Owens River, and Mr. Stephens noted it as rather common at Independence Creek, June 18–23; at Menache Meadows, May 24–26; several at Bishop Creek, August 4–10. Mr.

up to timber line at Menache Meadows, Calif., May 24–26, and a few at Bishop Creek August 4–10. Mr. Palmer reported it common among the pines at the summit of Frazier Mountain July 9; near the summit of Tejon Pass July 12; and Mr. Dutcher saw it frequently at Big Cottonwood Meadows during the summer. The pygmy nuthatch was not uncommon among the pines on the ridge above Walker Basin July 14, among the sequoias on the Kaweah River the first of August, at the Sequoia National Park about the same date, and at Big Cottonwood Meadows and Round Valley the last of the month.

Record of specimens collected of Sitta pygmæa.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
10	♂	Sierra Nevada, Calif	July 1, 1891	B. H. Dutcher	Big Cottonwood Meadows.
32	♂	......do	Aug. 11, 1891	....do	Do.
35		......do	Aug. 24, 1891	....do	Do.
152	♀	......do	Aug. 9, 1891	F. Stephens	Bishop Creek.
391	♀ im.	Walker Basin, Calif	July 14, 1891	A. K. Fisher	
425	♂	Sierra Nevada, Calif	Aug. 27, 1891	....do	Round Valley, 12 miles south of Mount Whitney.
426	♂	......do	....do	....do	Do.

Parus inornatus. Plain Titmouse.

The plain titmouse was first met with in the Sierra Nevada in California. It was not uncommon on the western slope of Walker Pass, where a specimen was taken July 3, and the birds seen elsewhere in the Sierra Nevada may probably be correctly referred to this species. It was common along the valley of the Kern July 3–13; in Walker Basin, July 13–16; and at Three Rivers in the western foothills of the Sierra, July 25–30, and September 13–15. Dr. Merriam saw the species in the Tejon Mountains, where it was common in the Cañada de las Uvas, June 28–29, and Mr. Nelson saw it at Mount Piños the last of October, in the hills along the route from La Panza to San Luis Obispo, and sparingly from the sea to the summit of the hills between San Simeon and Carpenteria, in November and December.

A specimen taken by the writer in Cajon Pass January 2, although not typical *inornatus*, was nearer it than *griseus*.

Record of specimens collected of Parus inornatus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
25	♂	Cajon Pass, Calif	Jan. 2, 1892	A. K. Fisher	Not typical.
367	♀ im.	Walker Pass, Calif	July 3, 1891	....do	Western slope.

Parus inornatus griseus. Gray Titmouse.

The gray titmouse was seen in most of the desert ranges. In the Charleston Mountains, Nevada, it was common among the junipers in

Psaltriparus minimus californicus. California Bush-Tit.

The California bush-tit is common in the coast region, on the western slope of the Sierra Nevada, and sparingly on the eastern slope of the same range. Mr. Stephens found it tolerably common in the lower part of the cañon at Independence Creek, where a nest containing young was found, June 16–23; and saw a small flock at Bishop Creek, August 4–10. Individuals were seen on the western slope of Walker Pass, July 2–3, and Dr. Merriam found it common in the chaparral from Kernville to Havilah, and thence to Walker Basin and Caliente, June 23–24, and in the Cañada de las Uvas, June 28–29. It was common at Three Rivers in the western foothills, in flocks of 25 or more, July 25–30, and Mr. Bailey reported it common along the Kaweah River up to the conifers, about the same time. The latter observer found a species of bush-tit common at Monterey, the first of October; Mr. Stephens saw two flocks at Reche Cañon, September 22–24; and Dr. Merriam noticed it near the coast in San Diego County in July. Mr. Nelson reported it common along the coast in small flocks in thickets and on bushy hill-sides, from San Simeon to Carpenteria, in November and December.

Record of specimens collected of Psaltriparus minimus californicus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
76	♀	Owens Valley, Calif.	June 8, 1891	F. Stephens	Olancha.
369		Walker Pass, Calif.	July 3, 1891	A. K. Fisher	Western Slope.

Psaltriparus plumbeus. Lead-colored Bush-Tit.

The lead-colored bush-tit is common in a number of the desert ranges visited. In Nevada Mr. Stephens found it rather common in the Grapevine Mountains in March, and saw one flock at the Queen mine in the White Mountains in July. Dr. Merriam found it high up on Mount Magruder in the nut pines, June 5–9, among the junipers in the Juniper Mountains May 19, and common in the Beaverdam Mountains, Utah, May 11. A few were seen by Mr. Stephens at Twelve Mile Spring, near Resting Springs, Calif., in February. In the Panamint Mountains it was observed daily in Johnson and Surprise Cañons in April, in small flocks on the north side of Telescope Peak April 17–19, and among the sage in the northern part of the range, as well as in the Grapevine Mountains May 4 to June 15. Mr. Nelson found a few among the piñons near Waucoba Peak in the Inyo Mountains the last of June, and a few on the eastern slope of the White Mountains among the same kind of trees in July.

Palmer found it common on Frazier Mountain July 9, sparingly at Tejon Pass, July 12; and Mr. Nelson reported it common on Mount Piños the last of October. In the High Sierra it was common in the Sequoia National Park the first week in August; at Horse Corral Meadows, August 9–13; at Round Valley, 12 miles south of Mount Whitney, August 27–28; Big Cottonwood Meadows during the summer; and at Whitney Meadows and Mineral King the last of August and first of September. Mr. Palmer saw one at an altitude of 3,900 meters (13,000 feet) near the head waters of the Kern River, September 1.

Record of specimens collected of Parus gambeli.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
40	♂	Grapevine Mountains, Nev.	Mar. 21, 1891	F. Stephens	
142	♂	Panamint Mountains, Calif.	Mar. 28, 1891	A. K. Fisher	Johnson Cañon.
151		do	April 6, 1891	do	Do.
152	♂	do	April 9, 1891	do	Do.
	♂	Argus Range, Calif	May 7, 1891	T. S. Palmer	Maturango Peak.
	♂	White Mountains, Calif.	July 12, 1891	E. W. Nelson	

Parus rufescens neglectus. California Chickadee.

Mr. Bailey found the California chickadee common at Boulder Creek, California (north of Monterey Bay), where he secured a specimen October 14, 1891.

Chamæa fasciata henshawi. Pallid Wren-Tit.

This interesting little bird was first met with by Mr. Bailey and the writer at Kernville, Calif., on July 11, where specimens were secured. It was common there, as it was the following week in Walker Basin. Mr. Nelson saw a few in the foothills between the Merced and San Joaquin rivers; Mr. Palmer heard a number among the chamisal in the San Francisquito Pass, July 1, and Mr. Stephens heard several in Reche Cañon, near San Bernardino, September 22–24. Mr. Bailey reported it common along the Kaweah River in the thick chapparal below the pines. Mr. Nelson found the ground-tit common in the thickets on the sand dunes along the coast between San Simeon and Carpenteria, and on the bushy hillsides between the latter place and Santa Paula, in November and December. Dr. Merriam reported it as a common breeder in the coast ranges of San Diego County, where he found it in March and again in July.

Record of specimens collected of Chamæa fasciata henshawi.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
385	♂	Kernville, Calif	July 11, 1891	A. K. Fisher	
	♀	do	do	V. Bailey	
167	♂	San Bernardino, Calif	Sept. 23, 1891	F. Stephens	Reche Cañon.
		Morro, Calif	Nov. 8, 1891	E. W. Nelson	

Psaltriparus minimus californicus. California Bush-Tit.

The California bush-tit is common in the coast region, on the western slope of the Sierra Nevada, and sparingly on the eastern slope of the same range. Mr. Stephens found it tolerably common in the lower part of the cañon at Independence Creek, where a nest containing young was found, June 16–23; and saw a small flock at Bishop Creek, August 4–10. Individuals were seen on the western slope of Walker Pass, July 2–3, and Dr. Merriam found it common in the chaparral from Kernville to Havilah, and thence to Walker Basin and Caliente, June 23–24, and in the Cañada de las Uvas, June 28–29. It was common at Three Rivers in the western foothills, in flocks of 25 or more, July 25–30, and Mr. Bailey reported it common along the Kaweah River up to the conifers, about the same time. The latter observer found a species of bush-tit common at Monterey, the first of October; Mr. Stephens saw two flocks at Reche Cañon, September 22–24; and Dr. Merriam noticed it near the coast in San Diego County in July. Mr. Nelson reported it common along the coast in small flocks in thickets and on bushy hill-sides, from San Simeon to Carpenteria, in November and December.

Record of specimens collected of Psaltriparus minimus californicus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
76	♀	Owens Valley, Calif.	June 8, 1891	F. Stephens	Olancha.
269		Walker Pass, Calif.	July 3, 1891	A. K. Fisher	Western Slope.

Psaltriparus plumbeus. Lead-colored Bush-Tit.

The lead-colored bush-tit is common in a number of the desert ranges visited. In Nevada Mr. Stephens found it rather common in the Grapevine Mountains in March, and saw one flock at the Queen mine in the White Mountains in July. Dr. Merriam found it high up on Mount Magruder in the nut pines, June 5–9, among the junipers in the Juniper Mountains May 10, and common in the Beaverdam Mountains, Utah, May 11. A few were seen by Mr. Stephens at Twelve Mile Spring, near Resting Springs, Calif., in February. In the Panamint Mountains it was observed daily in Johnson and Surprise Cañons in April, in small flocks on the north side of Telescope Peak April 17–19, and among the sage in the northern part of the range, as well as in the Grapevine Mountains May 4 to June 15. Mr. Nelson found a few among the piñons near Waucoba Peak in the Inyo Mountains the last of June, and a few on the eastern slope of the White Mountains among the same kind of trees in July.

Record of specimens collected of Psaltriparus plumbeus.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Juniper Mountains, Nev	May 19, 1891	C. Hart Merriam	
	♀	Mount Magruder, Nev	June 5, 1891	V. Bailey	
38	♀	Grapevine Mountains, Nev	Mar. 24, 1891	F. Stephens	
24	♀	Resting Springs, Calif	Feb. 21, 1891	do	
25	♀	do	do	do	
144	♀	Panamint Mountains, Calif	Mar. 28, 1891	A. K. Fisher	Johnson Cañon.
153		do	Apr. 9, 1891	do	Do.
169		do	Apr. 19, 1891	do	Surprise Cañon.
131	♀ im.	Owens Valley, Nev	July 11, 1891	F. Stephens	Queen station.

Auriparus flaviceps. Yellow-headed Tit.

The verdin is a characteristic bird of a large part of the Lower Sonoran zone. The most western locality at which it was observed by the expedition was Resting Springs, near the Amargosa River, Calif., where a male was shot by Mr. Stephens February 13, 1891. Here the yellow-headed tit was common in February, and it was seen every day among the mesquit thickets, and its nests were frequently found. As is the case with several other members of the family, the old nests, after being relined with feathers and hair, are used for winter homes. East of this point it was found wherever suitable thickets exist, all the way to Utah. Many nests were found in bushes of *Pluchea borealis* at the Great Bend of the Colorado, Nev., by Dr. Merriam. These nests were usually about five feet above the ground, and, with the exception of one containing three eggs nearly ready to hatch, were still empty. Other nests were observed along the Virgin River and the lower part of the Muddy May 7-10, and at Beaverdam Creek, Ariz., May 9-10; and a single nest was discovered near the junction of the Santa Clara with the Virgin in southwestern Utah May 14.

Regulus calendula. Ruby-crowned Kinglet.

The ruby-crowned kinglet was a common migrant or winter resident in the valleys visited, and occurred sparingly as a summer resident in the higher mountains. In Nevada a few were seen at Ash Meadows in March; in Pahrump Valley Mr. Nelson found it common among the willows at the ranch in February; Mr. Stephens observed it in full song in Oasis Valley in March; not uncommon in the Grapevine Mountains in the same month, and Dr. Merriam shot one at Mountain Spring, in the Charleston Mountains, April 30.

At San Bernardino, Calif., it was numerous in the bushes along the streams December 28-29, 1890, and on the slopes in Cajon Pass January 2. A few were seen at Furnace Creek, Death Valley, about the first of February and again April 9-12. In the Panamint Mountains this kinglet was common in Johnson and Surprise cañons, and tolerably so in Emigrant Cañon in April. It was common at Hot Springs, in Panamint Valley, April 20-25, and was observed in Shepherd Cañon, in the Argus Range, later in the month. Mr. Nelson saw a few at the heads of streams on the eastern slope of the White Mountains, and reported it common at the head of Owens River and on the western slope of the Sierra Nevada. It was common at timber line at Round Valley, 12 miles south of Mount Whitney, August 28; in the San Joaquin Valley in October; and along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Regulus satrapa olivaceus. Western Golden-crowned Kinglet.

The only record of this kinglet made by the expedition was of one seen by Mr. Nelson near San Luis Obispo about the first of November. Mr. Belding reports it as rare at Crocker's, 21 miles northwest of the Yosemite Valley.

Polioptila cærulea obscura. Western Gnatcatcher

Blue-gray gnatcatchers were common in a number of scattered localities. At San Bernardino, a small flock associated with other birds was seen December 28, and again on the following day. Several were seen at Daggett, January 8–10, and one was secured at Furnace Creek, Death Valley, January 24. The species was common in the Panamint Mountains, in both Johnson and Surprise cañons, in April, and at Hot Springs in Panamint Valley, among the mesquite, April 20–25. Mr. Nelson found it breeding in both the Panamint and Grapevine mountains. At Willow Creek, in the former range, he found a nest containing five eggs, May 19, and another containing three eggs, May 24. Both nests were placed within 3 feet of the ground, and were neat, compactly built structures, with deep cup-shaped depressions, more or less contracted at the rims. A few individuals were seen in the Argus Range, at Maturango Spring, the first half of May, and in the Coso Mountains during the latter part of the same month. Mr. Nelson saw a single bird in a mesquite clump in Saline Valley, a few in the sage near Waucoba Peak, in the Inyo Range, the last of June, and in the White Mountains in July. He saw a few in the western foothills of the Sierra Nevada in August, and on the east slope Mr. Stephens found it uncommon in the lower part of the cañon of Independence Creek, in June. One was seen on the western slope of Walker Pass, July 3; it was common in the hills above Walker Basin, July 14; along the Kaweah, below the conifers, in August and September; and Mr. Palmer saw one in Kings River Cañon, August 13. On Mount Magruder, Nevada, Dr. Merriam shot a pair June 7, and reported the species as tolerably common in the lower part of the piñons. He found it breeding commonly in the Santa Clara Valley, Utah, May 11–15, and in the junipers on the Beaverdam Mountains, May 10–11. Mr. Nelson found it common in the thickets along the coast from Morro, Calif., to Carpenteria, November 4 to December 18, and rather common from Carpenteria to Santa Paula, the last of the year.

Record of specimens collected of Polioptila cærulea obscura.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
9	♂	San Bernardino, Calif	Dec. 28, 1890	A. K. Fisher	
10	♂	do	do	do	
11		do	Dec. 29, 1890	do	
50	♂	Daggett, Calif	Jan. 10, 1891	do	Mohave Desert.
70		Death Valley, Calif	Jan. 24, 1891	do	Furnace Creek.
164	♂	Panamint Valley, Calif	Apr. 16, 1891	do	Hot Springs.
214	♂	Argus Range, Calif	May 8, 1891	do	Maturango Spring.
	♂	Panamint Valley, Calif	Apr. 22, 1891	E. W. Nelson	Hot Springs.
	♀	Mission Santa Ynez, Calif	Dec. 6, 1891	do	
	♂	St. George, Utah	May 16, 1891	V. Bailey	

Polioptila plumbea. Plumbeous Gnatcatcher.

This gnatcatcher was common at Resting Springs, near the Amargosa River, California, in February, where a number of specimens were secured. In Vegas Valley, Nevada, Mr. Nelson and Mr. Bailey saw several and secured one, March 13. At Bunkerville, Nev., Mr. Bailey secured an adult male, May 9. The species may have been seen in other places, but was not distinguished from the blue-gray gnatcatcher. In March, 1889, Mr. Bailey found it common at Fort Mohave, Ariz.

Record of specimens collected of Polioptila plumbea.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
103	♀	Resting Springs, Calif	Feb. 8, 1891	A. K. Fisher	
	♀	do	Feb. 12, 1891	V. Bailey	
	♀	do	do	do	
	♀	Vegas Valley, Nev	Mar. 13, 1891	do	
	♂	Bunkerville, Nev	May 9, 1891	do	

Polioptila californica. Black-tailed Gnatcatcher.

The only place where the Californian gnatcatcher was observed was Reche Cañon, near San Bernardino, where Mr. Stephens found it common, September 22–24.

Myadestes townsendii. Townsend's Solitaire.

Townsend's solitaire was found nowhere common by the expedition. In Cajon Pass, California, several were observed and two secured, January 2. One was shot at Lone Pine, in Owens Valley, in December, 1890, and others were seen at Hot Springs, Panamint Valley, in January.

In the Panamint Mountains, a few were seen in Johnson and Surprise cañons, in April. Mr. Nelson found a few among the piñons about the head of Willow Creek, the 1st of May, and the writer saw a family in Death Valley Cañon, June 22. In the Sierra Nevada, Mr. Nelson found it sparingly on the western slope opposite the head of Owens River; Mr. Stephens secured the young at Bishop Creek, the 1st of August; Mr. Bailey saw one among the sequoias and another among the *Pinus monticola* on the Kaweah River; a few were seen in the Giant forest, August 3; and several at Trout Meadows, September 7. Mr. Belding found a nest and four eggs, June 4, near Crocker's, on the Big Oak Flat and Yosemite Valley stage road. It was placed in a nearly perpendicular bank of a gold mine, within a short distance of the hoisting works, which were in constant use.

In Nevada Townsend's solitaire was not uncommon among the cedars on the Charleston Mountains in March, and a specimen was secured in Oasis Valley, March 15, the only one seen there.

Record of specimens collected of Myadestes townsendii.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
23	♀	Cajon Pass, Calif	Jan. 2, 1891	A. K. Fisher	
24	♀	do	do	do	
149	♂	Panamint Mountains, Calif	Mar. 31, 1891	do	Johnson Cañon.
22	♂	Oasis Valley, Nev	Mar. 15, 1891	F. Stephens	
169	♂ im.	Sierra Nevada, Calif	Aug. 8, 1891	do	Bishop Creek; altitude, 9,000 feet.

Turdus ustulatus. Russet-backed Thrush.

A female russet-backed thrush was shot by the writer at Maturango Springs, California, in the Argus Range, May 15, 1891, the only one observed there, and Mr. Stephens saw one at Olancha, in Owens Valley, about the same time.

Turdus ustulatus swainsonii. Olive-backed Thrush.

Mr. Belding reported this thrush as common in the Yosemite Valley, California, in June, and Mr. Nelson secured a female on the northern end of the Panamint Mountains, May 18.

Turdus aonalaschkæ. Dwarf Hermit Thrush.

The dwarf thrush was seen only during migration. Several were seen in Johnson Cañon, in the Panamint Range, California, where a specimen was secured March 28. In the Argus Range, it was not uncommon in Shepherd Cañon the last week in April, and at Maturango Spring one was secured May 8. Mr. Dutcher shot another at Big Cottonwood Meadows September 11, which was probably a migrant, as the summer resident was *auduboni*, or at least what the committee on nomenclature of the American Ornithologists' Union consider Audubon's thrush.

Mr. Bailey found the dwarf thrush common at Monterey the first of October, and Mr. Nelson observed it commonly in the vicinity of San Luis Obispo the last of the month, and along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Turdus aonalaschkæ.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♂	Panamint Mountains, Calif.	Mar. 28, 1891	E. W. Nelson	Johnson Cañon.
36		Sierra Nevada, Calif.	Sept. 11, 1891	B. H. Dutcher	Big Cottonwood Meadows.
	♀ ?	Monterey, Calif	Oct. 6, 1891	V. Bailey	
	♂	Morro, Calif	Nov. 10, 1891	E. W. Nelson	
	♀	do	do	do	

Turdus aonalaschkæ auduboni. Audubon's Hermit Thrush.

A race of the dwarf thrush, named *Turdus sequoiensis* by Mr. Belding, but which the committee on nomenclature of the American Ornithologists' Union decided to be not different from *auduboni* of the Rocky Mountain region, is a summer resident in the Sierra Nevada, and probably in some of the desert ranges, though this is not certain, as specimens were not taken in the latter in summer. This applies to the records of individuals seen at Willow Creek in the Panamint Mountains, during the latter part of May, and on the east side of Waucoba Peak, in the Inyo Mountains, in June. In the Sierra Nevada Mr. Dutcher found the species common during the summer at Big Cottonwood Meadows, and Mr. Nelson reported it as abundant at the head of Owens River and on the San Joaquin River. Mr. Stephens heard a thrush above the Queen mine in the White Mountains, Nevada, July 11–16; saw the species at Bishop Creek August 4–10, and about the lakes on Independence Creek June 18–23. Mr. Belding found it in the Yosemite Valley in June.

Record of specimens collected of Turdus aonalaschkæ auduboni.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
9		Sierra Nevada, Calif	June 23, 1891	B. H. Dutcher	Big Cottonwood Meadows.
16	♂	do	July 11, 1891	do	
	♀	White Mountains, Calif	July 10, 1891	E. W. Nelson	
	♂	Sierra Nevada, Calif	July 23, 1891	do	

Merula migratoria propinqua. Western Robin.

The robin is a rather rare bird in the desert regions, even during migration and in winter. In Nevada several were seen at Ash Meadows in March. Mr. Palmer found it rather common from the valley up to the piñons on the west side of the Charleston Mountains in February, and Mr. Nelson saw it about the ranches in Pahrump and Vegas valleys, and in Vegas Wash, in March. Dr. Merriam saw it on Mount Magruder June 8, and in Utah, at Mountain Meadows, May 17. In California a few were seen at Furnace Creek, Death Valley, the latter part of January, and again on April 10. Several were observed at Resting Springs, in the Amargosa Desert, the first half of February. A few robins were seen about a spring in Johnson Cañon, in the Panamint

Range, in April. Dr. Merriam saw several in the junipers in the same mountains April 16–19, and Mr. Nelson a few at the head of Willow Creek early in May, after which time none were seen. Several were seen in the Argus Range, above Maturango Spring, the first half of May. Mr. Nelson found it in the Inyo Mountains among *Pinus flexilis* and *P. aristata*, and in the White Mountains from the piñons up to 10,000 feet. In the Sierra Nevada robins were common in many places. Mr. Nelson found them common at the head of Owens River, on the east slope, and in the Yosemite Valley, on the west slope of the Sierra, in July and August. Mr. Stephens found them common at Independence Creek, where a nest and four young was found at the edge of the creek June 18–23; at Bishop Creek, where they were feeding on a red berry locally known as buffalo berry, August 4–10, and at Menache Meadow, nearly to timber line, May 24–26. They were common also at Big Cottonwood and Whitney meadows; among the pines above Walker Basin July 14, in the Sequoia National Park, among the pines and firs, and in the meadows, the first week in August; at Horse Corral Meadows, August 9–13; in Kings River Cañon, August 13–16, and near Mineral King September 9–12. In the western foothills of the Sierra they were seen as early as July 30 at Three Rivers, and Mr. Nelson found a few in the San Joaquin Valley October 5–27; reported them as common about San Luis Obispo October 28 to November 4, and found them generally distributed along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Merula migratoria propinqua.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
85	♂	Death Valley, Calif	Jan. 29, 1891	A. K. Fisher	Furnace Creek.
108	♂	Resting Springs, Calif	Feb. 11, 1891	....do	
	♂	Panamint Mountains, Calif	Mar. 28, 1891	E. W. Nelson	Johnson Canon.
107	♀ juv.	Owens Valley, Calif	June 19, 1891	F. Stephens	Independence Creek

Hesperocichla nævia. Varied Thrush.

Mr. Bailey saw several varied thrushes and secured a specimen at Monterey, Calif., the first week in October; he also found it common at Boulder Creek, Santa Cruz County, and at Auburn, Placer County, during the latter part of the month. Mr. Nelson observed a few in the lowlands about San Simeon, and found it common from Santa Maria south to Carpenteria and Santa Paula, where it was particularly numerous among the trees along the streams and in the cañon.

Record of specimens collected of Hesperocichla nævia.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
	♀	Monterey, Calif	Oct. 5, 1891	V. Bailey	
	♂	Boulder Creek, Calif	Oct. 12, 1891	....do	

Sialia mexicana. Western Bluebird.

The western bluebird was common in a number of places. At San Bernardino a flock of twenty or more was seen December 29, 1890; in Cajon Pass, March 30; in the cottonwoods bordering the Mohave River at Victor, the same day, and at Granite Wells January 13. Mr. Nelson found the species common near Hot Springs, in Panamint Valley, California, in January, and a few at Pahrump and Vegas ranches in Nevada, in February and March. Dr. Merriam saw several small flocks on the north side of Telescope Peak, in the Panamint Mountains, April 17–19, and Mr. Nelson found it on the western slope of the Sierra Nevada in August. It was very common along the South Fork of the Kern River, July 3–10; in Walker Basin, from the valley to the summit of the ridge, July 13–16, and in the Cañada de las Uvas, June 28–29. In the High Sierra it was not uncommon at Sequoia National Park during the first week of August; was common in Horse Corral Meadows and Kings River Cañon August 9–16, and was observed at Big Cottonwood Meadows and at the head of the Kaweah River later in the season. In the western foothills of the Sierra, at Three Rivers, it was common July 25–30 and September 12–16; and at Monterey, September 28–October 9. Mr. Nelson saw a few in various parts of the San Joaquin Valley in October, and found it common along the route from San Simeon to Carpenteria and Santa Paula in November and December.

Record of specimens collected of Sialia mexicana.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
13	♀	San Bernardino, Calif	Dec. 29, 1890	A. K. Fisher	
14	♂	do	do	do	
15	♂	do	do	do	
	♂	Charleston Mountains, Nev	Feb. 13, 1891	E. W. Nelson	
370	♀ juv.	Kern River, Calif	July 4, 1891	A. K. Fisher	South Fork.
39	♂	Sierra Nevada, Calif	Sept. 14, 1891	B. H. Butcher	Mount Whitney.

Sialia arctica. Mountain Bluebird.

The mountain bluebird is more or less common in the desert valleys during the winter, and breeds in the higher ranges among the pines.

At Granite Wells, in the Mohave Desert, a number were seen January 13–14. Unlike the western bluebird, this species was wary and difficult of approach. It is not evident what causes this shyness, unless, perhaps, contact with the Indian, that ruthless and inveterate enemy to animal life, who attacks every bird throughout the year, no matter how small or in what condition, killing the mother of a dependent brood with as much eagerness as a fattened buck in season.

In Death Valley a flock was seen at Mesquite Well, January 21. It was common at Bennett Wells and Saratoga Springs, and at Furnace Creek, associated with titlarks and savanna sparrows in the alfalfa fields, the last of January. Several were seen at Resting Springs, in the Amargosa Desert, in February. Dr. Merriam saw a pair at Mountain Meadows, Utah, May 17. In Nevada he found several in the juniper forest on the Juniper Mountains, May 18; on the Pahroc Mountains, May 21–22, and on Mount Magruder, June 4–8. In the latter locality this bluebird was breeding among the nut pines, where it was tolerably common. Several were seen at Ash Meadows, and among the cedars on the Charleston Mountains, in March, and in Pahrump Valley, near the ranch, in February. Mr. Stephens found it not common in the Grapevine Mountains in March, and Mr. Nelson saw a few pairs about the summit of the peak and among the piñons, where they were apparently breeding, June 10–11. In the Panamint Mountains, California, Dr. Merriam saw several pairs at the north base of Telescope Peak, April 17–19, and Mr. Bailey and the writer found a number among the pines (*Pinus aristata* and *P. flexilis*), near the summit of the same peak, June 23. It was not uncommon in the Argus Range above Maturango Spring during the first half of May, and a pair was seen on the summit of the Coso Mountains, May 23. Mr. Nelson found it not uncommon in the Inyo Range above the piñons in June; a few among the upper piñons in the White Mountains in July, and at the latter place Dr. Merriam saw a number of males June 9—the females evidently were sitting. In Owens Valley, according to Mr. Nelson, it was common in winter, and Mr. Stephens found it more or less common above this valley along the eastern slope of the Sierra Nevada up to timber line at Menache Meadows, May 24–26; at the lakes on Independence Creek, June 23; among the piñons at Benton, July 9–10, and at the lake on Bishop Creek, August 4–10. Mr. Nelson reported it generally distributed up to timber line at the head of Owens River the last of July, but nowhere common, and Mr. Stephens found it common at the Queen mine in the White Mountains, Nevada, July 11–16. Mr. Bailey saw a few on the western slope of Walker Pass, July 3, found it common at timber line near the head of the Kaweah River, in August, and at Whitney Meadows in September. Mr. Dutcher found it a common summer resident at Big Cottonwood Meadows and vicinity, and Mr. Nelson saw a few on the high ridge near San Luis Obispo, and in the mountains along the coast from San Simeon to Carpenteria in November and December.

Record of specimens collected of Sialia arctica.

Collector's No.	Sex.	Locality.	Date.	Collector.	Remarks.
35	♂	Granite Wells, Calif.	Jan. 14, 1891	A. K. Fisher	
	♂	Death Valley, Calif.	Jan. 20, 1891	E. W. Nelson	Bennett Wells.
67	♂	......do	Jan. 30, 1891	A. K. Fisher	Furnace Creek.
69	♂	......do	....do	....do	Do.
14	♂	Garlick Spring, Calif.	Feb. 10, 1891	F. Stephens	
15	♂	......do	....do	....do	
125	♀	Ash Meadows, Nev.	Mar. 13, 1891	A. K. Fisher	
23	♀	Grapevine Mountains, Nev.	Mar. 21, 1891	F. Stephens	
[illegible]	♂	Argus Range, Calif.	May 13, 1891	A. K. Fisher	Maturango Spring.

LIST OF BIRDS OBSERVED IN DEATH VALLEY, CALIFORNIA.

1. *Colymbus nigricollis californicus.* Eared Grebe.
   A specimen was secured at Furnace Creek April 10.
2. *Anas boschas.* Mallard.
   One was secured at Furnace Creek in January.
3. *Anas americana.* Baldpate.
   The species was secured at Saratoga Springs and Furnace Creek in January.
4. *Anas carolinensis.* Green-winged Teal.
   Common at Furnace Creek and Saratoga Springs in January.
5. *Anas cyanoptera.* Cinnamon Teal.
   At Furnace Creek flocks were seen in March, and one female secured June 19.
6. *Spatula clypeata.* Shoveller.
   A small flock seen at Furnace Creek in January.
7. *Dafila acuta.* Pintail.
   Seen and secured at Saratoga Springs in February.
8. *Erismatura rubida.* Ruddy Duck.
   A small flock was seen at Furnace Creek March 22.
9. *Anser albifrons gambeli.* White-fronted Goose.
   One was seen with the following subspecies.
10. *Branta canadensis* (subspecies?)
    Four were seen at Furnace Creek in the latter part of March.
11. *Plegadis guarauna.* White-faced Glossy Ibis.
    The remains of one were seen at the ranch at Furnace Creek.
12. *Nycticorax nycticorax nævius.* Night Heron.
    An immature specimen was secured at Furnace Creek June 19.
13. *Rallus virginianus.* Virginia Rail.
    Common at Saratoga Springs in February.
14. *Fulica americana.* Coot.
    Common at Saratoga Springs in February and April.
15. *Phalaropus tricolor.* Wilson's Phalarope.
    One specimen was secured at Furnace Creek June 19.
16. *Gallinago delicata.* Wilson's Snipe.
    One seen at Furnace Creek April 11.
17. *Ægialitis vocifera.* Killdeer.
    Not uncommon; found at Furnace Creek in January, April, and June; breeds.
18. *Callipepla gambeli.* Gambel's Quail.
    Common at Furnace Creek ranch. Introduced.
19. *Zenaidura macroura.* Mourning Dove.
    Not uncommon; breeds.
20. *Cathartes aura.* Turkey Buzzard.
    Not uncommon; seen in March, April, and June.
21. *Circus hudsonius.* Marsh Hawk.
    One was secured at Furnace Creek in January.
22. *Accipiter velox.* Sharp-shinned Hawk.
    Seen at Furnace Creek and Bennett Wells in January and April.
23. *Accipiter cooperi.* Cooper's Hawk.
    Seen at Furnace Creek in January.
24. *Buteo borealis calurus.* Western Red tail.
    Seen at Furnace Creek and Bennett Wells in January, and at the latter place in June.
25. *Falco mexicanus.* Prairie Falcon.
    Seen at Furnace Creek in January and June.
26. *Falco columbarius.* Pigeon Hawk.
    Remains of one found at Furnace Creek.

27. *Falco sparverius deserticolus.* Desert Sparrow Hawk.
Seen at Mesquite Wells, Bennett Wells, and Furnace Creek in January, March, and April.

28. *Pandion haliaëtus carolinensis.* Osprey.
One was seen at Furnace Creek April 10.

29. *Speotyto cunicularia hypogæa.* Burrowing Owl.
A pair was seen at Bennett Wells June 21.

30. *Geococcyx californianus.* Road-runner.
Common resident.

31. *Coccyzus americanus occidentalis.* California Cuckoo.
One secured at Furnace Creek June 20.

32. *Ceryle alcyon.* Kingfisher.
One seen at Furnace Creek April 15.

33. *Colaptes cafer.* Red-shafted Flicker.
One was seen at Furnace Creek, April 10.

34. *Phalænoptilus nuttalli.* Poor-will.
Secured at Bennett Wells January 28, at Saratoga Springs February 4, and seen at Furnace Creek April 10.

35. *Chordeiles virginianus henryi.* Western Nighthawk.
A specimen was secured at Furnance Creek June 19.

36. *Chordeiles texensis* Texas Nighthawk.
Seen at Saratoga Springs April 26.

37. *Aëronautes melanoleucus.* White-throated Swift.
Common at Furnace Creek in April and June.

38. *Calypte costæ.* Costa's Hummingbird.
Seen at Furnace Creek April 12 and again June 19.

39. *Myiarchus cinerascens.* Ash-throated Flycatcher.
A pair was seen in Furnace Creek Cañon June 21.

40. *Sayornis saya.* Say's Phœbe.
Not uncommon resident.

41. *Sayornis nigricans.* Black Phœbe.
It was seen at Furnace Creek April 12.

42. *Empidonax wrightii.* Wright's Flycatcher.
A specimen was taken at Furnace Creek February 1.

43. *Corvus corax sinuatus.* Raven.
Resident.

44. *Molothrus ater.* Cowbird.
One was secured at Furnace Creek June 20.

45. *Xanthocephalus xanthocephalus.* Yellow-headed Blackbird.
One was secured at Bennett Wells April 1.

46. *Agelaius phœniceus.* Red-winged Blackbird.
A flock was seen at Furnace Creek the latter part of January.

47. *Sturnella magna neglecta.* Western Meadowlark.
A not uncommon resident.

48. *Icterus bullocki.* Bullock's Oriole.
One was observed at Furnace Creek about the middle of April.

49. *Scolecophagus cyanocephalus.* Brewer's Blackbird.
A few were seen at Furnace Creek in January.

50. *Carpodacus mexicanus frontalis.* House Finch.
Not uncommon resident.

51. *Ammodramus sandwichensis alaudinus.* Western Savanna Sparrow.
Not uncommon at Furnace Creek in January and April.

52. *Zonotrichia leucophrys intermedia.* Intermediate Sparrow.
Common at Furnace Creek in January and April.

53. *Spizella breweri.* Brewer's Sparrow.
One was seen in Mesquite Valley April 13.

54. *Amphispiza bilineata.* Black-throated Sparrow.
Seen on June 22 in the Panamint Mountains just above the valley.

55. *Amphispiza belli nevadensis.* Sage Sparrow.
Common winter resident.

56. *Melospiza fasciata montana.* Mountain Song Sparrow.
Common winter resident at Furnace Creek and Saratoga Springs.

57. *Guiraca cærulea eurhyncha.* Western Blue Grosbeak.
One was secured at Furnace Creek, June 19.

58. *Passerina amœna.* Lazuli Bunting.
A female was secured at Furnace Creek, June 19.

59. *Tachycineta bicolor.* Tree Swallow.
Common at Furnace Creek in March and April.

60. *Tachycineta thalassina.* Violet Green Swallow.
Observed at Furnace Creek and Saratoga Springs in April.

61. *Stelgidopteryx serripennis.* Rough-winged Swallow.
A not uncommon summer resident.

62. *Lanius ludovicianus excubitorides.* White-rumped Shrike.
Seen at Furnace Creek and Saratoga Springs in January.

63. *Vireo belli pusillus.* Least Vireo.
A not uncommon summer resident.

64. *Dendroica auduboni.* Audubon's Warbler.
Seen at Furnace Creek in January and April.

65. *Geothlypis trichas occidentalis.* Western Yellow-throat.
A not uncommon summer resident.

66. *Icteria virens longicauda.* Long-tailed Chat.
A not uncommon summer resident.

67. *Anthus pensilvanicus.* Titlark.
Winter resident.

68. *Oroscoptes montanus.* Sage Thrasher.
One seen at Mesquite Well in January.

69. *Mimus polyglottos.* Mockingbird.
Observed in January and April.

70. *Harporhynchus lecontei.* Le Conte's Thrasher.
An uncommon resident; seen at Saratoga Springs, Bennett Wells, Furnace Creek, and in the northwest arm or Mesquite Valley.

71. *Salpinctes obsoletus.* Rock Wren.
One was seen at Mesquite Wells in January; breeds in the mountains just above the valley.

72. *Catherpes mexicanus conspersus.* Cañon Wren.
One was seen at Saratoga Springs in February.

73. *Thryothorus bewickii bairdi.* Baird's Wren.
Seen at Furnace Creek, Bennett Wells, and Saratoga Springs in January.

74. *Cistothorus palustris paludicola.* Tule Wren.
Seen at Furnace Creek, Bennett Wells, and Saratoga Springs in January.

75. *Regulus calendula.* Ruby-crowned Kinglet.
Seen at Furnace Creek in February and April.

76. *Polioptila cærulea obscura.* Western Gnatcatcher.
One secured at Furnace Creek, January 24.

77. *Merula migratoria propinqua.* Western Robin.
A few were seen at Furnace Creek in January.

78. *Sialia arctica.* Mountain Bluebird.
A common winter resident.

LIST OF BIRDS FOUND IN OWENS VALLEY, CALIFORNIA.

1. *Colymbus nigricollis californicus.* Eared Grebe.
   Abundant on Owens Lake; breeds at the smaller lakes.
2. *Larus californicus.* California Gull.
   Seen in December, 1890.
3. *Larus delawarensis.* Ring-billed Gull.
   Seen at Lone Pine and Owens Lake in December, 1890.
4. *Larus philadelphia.* Bonaparte's Gull.
   One seen at Lone Pine, about the same time as the other gulls.
5. *Pelecanus erythrorhynchos.* White Pelican.
   A flock was seen at Haway Meadows in May and an individual at Lone Pine in August.
6. *Merganser serrator.* Red-breasted Merganser.
   Seen at Lone Pine and Owens Lake in winter.
7. *Anas boschas.* Mallard.
   Not uncommon; probably breeds.
8. *Anas discors.* Blue-winged Teal.
   Seen at Little Owens Lake in May.
9. *Anas cyanoptera.* Cinnamon Teal.
   Seen at Little Owens Lake; breeds.
10. *Spatula clypeata.* Shoveller.
    Common during migrations.
11. *Aythya americana.* Redhead.
    One was seen at Little Owens Lake in May.
12. *Glaucionetta clangula americana.* Golden-eye.
    Seen at Lone Pine, in December, 1890.
13. *Charitonetta albeola.* Buffle-head.
    Seen at Lone Pine in December, 1890.
14. *Branta canadensis* (subspecies?).
    A flock heard at Lone Pine in December, 1890.
15. *Dendrocygna fulva.* Fulvous Tree Duck.
    Breeds at Little Owens Lake.
16. *Plegadis guarauna.* White-faced Glossy Ibis.
    Seen at Little Owens Lake in May.
17. *Botaurus lentiginosus.* Bittern.
    Seen at Lone Pine in winter, and at Alvord and Bishop in summer.
18. *Ardea herodias.* Great Blue Heron.
    Seen at Lone Pine, and at Little Owens Lake in June.
19. *Ardea virescens.* Green Heron.
    Seen at Little Owens Lake in May.
20. *Nycticorax nycticorax nævius.* Night Heron.
    Not uncommon in the valley.
21. *Rallus virginianus.* Virginia Rail.
    Breeds at Lone Pine.
22. *Porzana carolina.* Sora.
    Seen at Little Owens Lake early in May.
23. *Fulica americana.* Coot.
    Common; breeds.
24. *Phalaropus tricolor.* Wilson's Phalarope.
    Two specimens were secured at Alvord, June 27.
25. *Recurvirostra americana.* Avocet.
    Seen at Little Owens Lake in May, 1891, at Owens Lake in June, at the north end of the valley in July, and Lone Pine in December, 1890.

26. *Gallinago delicata.* Wilson's Snipe.
Seen at Lone Pine in winter.
27. *Tringa minutilla.* Least Sandpiper.
Common at Owens Lake in December, 1890.
28. *Ereunetes occidentalis.* Western Sandpiper.
Secured at Owens Lake in June.
29. *Totanus melanoleucus.* Greater Yellow-legs.
Seen at Lone Pine in December.
30. *Numenius longirostris.* Long-billed Curlew.
Seen at Owens Lake in December and June.
31. *Ægialitis vocifera.* Killdeer.
Common; breeds.
32. *Ægialitis nivosa.* Snowy Plover.
Not uncommon at Owens Lake, where it is a resident.
33. *Oreortyx pictus plumiferus.* Plumed Quail.
Common along the eastern slope of the Sierra Nevada.
34. *Callipepla californica vallicola.* Valley Quail.
Common resident.
35. *Zenaidura macroura.* Mourning Dove.
Abundant breeder.
36. *Cathartes aura.* Turkey Buzzard.
Seen all through the valley.
37. *Circus hudsonius.* Marsh Hawk.
Not uncommon; breeds.
38. *Accipiter velox.* Sharp-shinned Hawk.
Seen at Olancha and Bishop Creek in the latter part of May and first part August.
39. *Accipiter cooperi.* Cooper's Hawk.
Seen at Bishop Creek in August.
40. *Accipiter atricapillus striatulus.* Goshawk.
A hawk thought to be this species was seen at Lone Pine in December, 1890.
41. *Buteo borealis calurus.* Western Red-tail.
Resident; more or less common.
42. *Aquila chrysaëtos.* Golden Eagle.
A pair was seen in June.
43. *Falco mexicanus.* Prairie Falcon.
Not uncommon; undoubtedly breeds in the neighboring mountains.
44. *Falco columbarius.* Pigeon Hawk.
Seen at Little Owens Lake.
45. *Falco sparverius deserticolus.* Desert Sparrow Hawk.
A more or less common resident throughout the valley.
46. *Strix pratincola.* Barn Owl.
The remains of one were found at Alvord.
47. *Speotyto cunicularia hypogæa.* Burrowing Owl.
A not uncommon resident.
48. *Geococcyx californianus.* Road-runner.
A common resident.
49. *Coccyzus americanus occidentalis.* California Cuckoo.
One seen at Bishop, August 11.
50. *Ceryle alcyon.* Kingfisher.
Not uncommon; breeds.
51. *Dryobates villosus hyloscopus.* Cabanis's Woodpecker.
Seen at Bishop Creek in August.
52. *Melanerpes torquatus.* Lewis's Woodpecker.
One seen at the head of the valley in July.

53. *Colaptes cafer.* Red-shafted Flicker.
A not uncommon resident.
54. *Phalænoptilus nuttalli.* Poor-will.
Not uncommon; breeding throughout the valley.
55. *Chordeiles texensis.* Texas Nighthawk.
A common summer resident.
56. *Cypseloides niger.* Black Swift.
Common; breeds in the mountains on each side of the valley.
57. *Chætura vauxii.* Vaux's Swift.
Seen at Olancha about the middle of May.
58. *Aëronautes melanoleucus.* White-throated Swift.
A common summer resident.
59. *Trochilus alexandri.* Black-chinned Humming Bird.
A common summer resident.
60. *Calypte costæ.* Costa's Humming Bird.
A common summer resident.
61. *Tyrannus verticalis.* Arkansas Kingbird.
A common summer resident.
62. *Tyrannus tyrannus.* Kingbird.
One was seen at Olancha, June 29.
63. *Myiarchus cinerascens.* Ash-throated Flycatcher.
A not uncommon summer resident.
64. *Sayornis saya.* Say's Phœbe.
A not uncommon breeding species.
65. *Sayornis nigricans.* Black Phœbe.
Seen and apparently breeding at Little Owens Lake and Bishop Creek.
66. *Contopus richardsoni.* Western Wood Pewee.
A common summer resident.
67. *Empidonax pusillus.* Little Flycatcher.
Seen at Olancha in May, and at Lone Pine June 11.
68. *Empidonax wrightii.* Wright's Flycatcher.
Found at Olancha in May, and at Bishop Creek in August.
69. *Otocoris alpestris arenicola.* Desert Horned Lark.
A common summer resident.
70. *Otocoris alpestris chrysolæma.* Mexican Horned Lark.
Found at Owens Lake in December, 1890.
71. *Cyanocitta stelleri frontalis.* Blue-fronted Jay.
Seen at Bishop Creek in August.
72. *Aphelocoma californica.* California Jay.
Found on the east slope of the Sierra Nevada.
73. *Corvus corax sinuatus.* Raven.
Resident.
74. *Picicorvus columbianus.* Clarke's Nutcracker.
Observed at the head of the valley and Bishop Creek.
75. *Cyanocephalus cyanocephalus.* Piñon Jay.
Seen at Benton and Bishop Creek.
76. *Xanthocephalus xanthocephalus.* Yellow-headed Blackbird.
A not uncommon resident.
77. *Agelaius phœniceus.* Red-winged Blackbird.
A common resident.
78. *Agelaius gubernator.* Bicolored Blackbird.
A specimen was secured at Olancha, June 11.
79. *Sturnella magna neglecta.* Western Meadowlark.
A common resident.

80. *Icterus bullocki.* Bullock's Oriole.
A common summer resident.

81. *Scolecophagus cyanocephalus.* Brewer's Blackbird.
A common summer resident. It may be a resident.

82. *Carpodacus mexicanus frontalis.* House Finch.
A common resident.

83. *Spinus psaltria.* Arkansas Goldfinch.
A common summer resident.

84. *Poocætes gramineus confinis.* Western Vesper Sparrow.
Not uncommon at the head of the valley.

85. *Ammodramus sandwichensis alaudinus.* Western Savanna Sparrow.
A not uncommon resident.

86. *Chondestes grammacus strigatus.* Western Lark Sparrow.
A common summer resident.

87. *Zonotrichia leucophrys.* White-crowned Sparrow.
Observed along the east slope of the Sierra Nevada, where it breeds higher up.

88. *Spizella breweri.* Brewer's Sparrow.
A common summer resident.

89. *Spizella atrigularis.* Black-chinned Sparrow.
Secured at Independence Creek on the east slope of the Sierra Nevada.

90. *Junco hyemalis thurberi.* Thurber's Junco.
Winter visitant in the valley; breeds on the east slope of the Sierra Nevada.

91 *Amphispiza bilineata.* Black-throated Sparrow.
A common summer resident.

92. *Amphispiza belli nevadensis.* Sage Sparrow.
A not uncommon resident.

93. *Melospiza fasciata heermanni.* Heermann's Song Sparrow.
Tolerably common resident.

94. *Melospiza lincolni.* Lincoln's Sparrow.
Found breeding at Independence Creek, on the east slope of the Sierra Nevada.

95. *Passerella iliaca megarhyncha.* Thick-billed Sparrow.
Found in the same place as the preceding species.

96. *Pipilo maculatus megalonyx.* Spurred Towhee.
A not uncommon resident.

97. *Pipilo chlorurus.* Green-tailed Towhee.
A common summer resident in the upper end of the valley.

98. *Habia melanocephala.* Black-headed Grosbeak.
Seen at Olancha and Ash Creek in May, and Independence Creek in June.

99. *Guiraca cærulea eurhyncha.* Western Blue Grosbeak.
A common summer resident.

100. *Passerina amœna.* Lazuli Bunting.
A common summer resident.

101. *Piranga ludoviciana.* Western Tanager.
A not uncommon summer resident.

102. *Petrochelidon lunifrons.* Cliff Swallow.
A common summer resident.

103. *Chelidon erythrogaster.* Barn Swallow.
A common summer resident.

104. *Tachycineta thalassina.* Violet Green Swallow.
A common summer resident.

105. *Clivicola riparia.* Bank Swallow.
Common at Alvord the last of June, where it was breeding.

106. *Stelgidopteryx serripennis.* Rough-winged Swallow.
A not uncommon summer resident.

107. *Ampelis cedrorum.* Cedar Bird.
A pair was seen at Lone Pine June 14.

108. *Phainopepla nitens.* Phainopepla.
One was seen at Morans in July.

109. *Lanius ludovicianus excubitorides.* White-rumped Shrike.
A common resident.

110. *Vireo gilvus swainsoni.* Western Warbling Vireo.
A not uncommon summer resident.

111. *Vireo belli pusillus.* Least Vireo.
A not uncommon summer resident.

112. *Helminthophila celata lutescens.* Lutescent Warbler.
A few migrants were seen at Little Owens Lake in May.

113. *Dendroica æstiva.* Yellow Warbler.
A common summer resident.

114. *Dendroica auduboni.* Audubon's Warbler.
Occurs in winter, and probably breeds on Independence and Bishop creeks.

115. *Dendroica townsendi.* Townsend's Warbler.
Migrants were seen at Little Owens Lake.

116. *Geothlypis macgillivrayi.* Macgillivray's Warbler.
Found with young at Bishop Creek in August.

117. *Geothlypis trichas occidentalis.* Western Yellow-throat.
A common summer resident.

118. *Icteria virens longicauda.* Long-tailed Chat.
A common summer resident.

119. *Sylvania pusilla pileolata.* Pileolated Warbler.
A not uncommon migrant.

120. *Anthus pensilvanicus.* Titlark.
A common winter resident.

121. *Cinclus mexicanus.* Water Ousel.
Follows down the streams into the valley in winter.

122. *Oroscoptes montanus.* Sage Thrasher.
Breeds commonly in the upper part of the valley.

123. *Mimus polyglottos.* Mockingbird.
A not uncommon resident.

124. *Harporhynchus lecontei.* LeConte's Thrasher.
A common resident.

125. *Heleodytes brunneicapillus.* Cactus Wren.
Breeds in the southern end of the valley.

126. *Salpinctes obsoletus.* Rock Wren.
A common resident.

127. *Thryothorus bewickii bairdi.* Baird's Wren.
Common at Lone Pine in December, 1890.

128. *Troglodytes aëdon aztecus.* Western House Wren.
Seen in migrations and probably breeds on the eastern slope of the Sierra Nevada.

129. *Cistothorus palustris paludicola.* Tule Wren.
A not uncommon resident.

130. *Parus gambeli.* Mountain Chickadee.
Rather common along the eastern slope of the Sierra Nevada.*

131. *Psaltriparus minimus californicus.* California Bush-Tit.
Seen on Independence and Bishop creeks.

132. *Polioptila cærula obscura.* Western Gnatcatcher.
Seen at Independence Creek in June.

133. *Myadestes townsendii.* Townsend's Solitaire.
Seen at Lone Pine in December, 1890.

134. *Turdus ustulatus.* Russet-backed Thrush.
One seen at Olancha about the middle of May.

135. *Turdus aonalaschkæ auduboni.* Audubon's Hermit Thrush.
Breeds on Independence and Bishop creeks.

136. *Merula migratoria propinqua.* Western Robin.
Common summer resident along the eastern slope of the Sierra Nevada.

137. *Sialia arctica.* Mountain Bluebird.
Commom along the eastern slope of the Sierra Nevada.

ANNOTATED LIST OF THE REPTILES AND BATRACHIANS COLLECTED BY THE DEATH VALLEY EXPEDITION IN 1891, WITH DESCRIPTIONS OF NEW SPECIES.

By LEONHARD STEJNEGER,

Curator of the Department of Reptiles and Batrachians, U. S. National Museum.

With field notes by Dr. C. HART MERRIAM.

Since the days of the great western surveying expeditions, the United States Exploring Expedition (Wilkes'), the United States and Mexican Boundary Survey, the various Pacific Railroad surveys, and Wheeler's Survey West of the one-hundredth Meridian, no collection of North American reptiles and batrachians has been made equaling or even approaching that brought home by the Death Valley Expedition. In the extent of the series of many species it stands unrivaled, and in the accuracy and detail of its labeling it surpasses them all. To this point particularly it is desired to call attention. Many of the specimens of the older collection have the localities very vaguely indicated, as 'California;' 'From San Diego to El Paso;' in others, detailed localities are given, but in such a way that in many cases it is impossible to identify them; in others, the labels have been changed, and errors resulted; others again were never labeled, or the labels were lost. In the collection of the Death Valley Expedition all the nine hundred specimens are individually and fully labeled; altitudes are frequently given, and there is not the slightest doubt as to the correctness of the statement attached to each and every specimen.

Furthermore, the collection is particularly noteworthy as it is the first attempt in this country on a similar scale to gather the herpetological material together according to a rational plan and with a definite purpose in view. The result is a fine series of specimens, unique in its completeness with respect to geographic localities within the area explored by the expedition, a tract of almost 100,000 square miles, comprising a number of nearly parallel desert valleys separated by intervening barren mountain ranges. The effort of the expedition to collect every species in all the characteristic localities from California to Utah and Arizona resulted in a material by which it has been possible in many instances to follow the geographic variation in its various directions. The present report does not pretend to exhaust this material, which will yield more definite results when the adjoining territory shall have been searched as thoroughly and as intelligently as that covered by the present expedition.

With a material so well calculated to show the amount of individual variation within many species, and to determine the geographical distribution of others, the author was enabled to settle many a vexed question and to point out many a nice distinction where some of his colleagues had failed, chiefly from lack of suitable material. If, therefore, he has succeeded in somewhat advancing our knowledge of North American herpetology, thanks are principally due to Dr. C. Hart Merriam, the untiring organizer and leader of the expedition, and to the zeal and intelligence of his assistants who evidently spared no effort to make the expedition a success. Personally I have to thank Dr. Merriam for the privilege of working up such a valuable and interesting material.

Dr. Merriam has contributed field notes on many of the species, with special reference to geographic distribution and food habits. These notes are given in brackets over his initials at the end of the text relating to each species.

LIST OF SPECIES.

A. REPTILIA.

I.—TESTUDINES.

TESTUDINIDÆ.

1. **Gopherus agassizii** (Cooper).
2. **Clemmys marmorata** (B. & G.).

II.—SQUAMATA.

1. Sauri.

EUBLEPHARIDÆ.

3. **Coleonyx variegatus** (Baird).

IGUANIDÆ.

4. **Dipsosaurus dorsalis** (B. & G).
5. **Crotaphytus baileyi** Stejn.
6. **Crotaphytus wislizenii** B. & G.
7. **Crotaphytus silus** Stejn.
8. **Callisaurus ventralis** (Hallow.).
9. **Sauromalus ater** Dum.
10. **Uta stansburiana** B. & G.
11. **Uta graciosa** (Hallow.).
12. **Sceloporus magister** Hallow.
13. **Sceloporus graciosus** B. & G.
14. **Sceloporus bi-seriatus** Hallow.
15. **Sceloporus occidentalis** B. & G.
16. **Phrynosoma blainvillii** Gray.
17. **Phrynosoma platyrhinos** Girard.

HELODERMATIDÆ.

18. **Heloderma suspectum** Cope.

ANGUIDÆ.

19. **Gerrhonotus scincicauda** (Skilton).
20. **Gerrhonotus scincicauda palmeri** Stejn.
21. **Gerrhonotus burnettii** Gray.

XANTUSIIDÆ.

22. **Xantusia vigilis** Baird.

TEJIDÆ.

23. **Cnemidophorus tigris** B. & G.
24. **Cnemidophorus tigris undulatus** (Hallow.).

SCINCIDÆ.

25. **Eumeces skiltonianus** B. & G.

2. **Serpentes.**

LEPTOTYPHLOPIDÆ.

26. **Rena humilis** B. & G.

BOIDÆ.

27. **Charina plumbea** B. & G.

NATRICIDÆ.

28. **Diadophis pulchellus** B. & G.
29. **Lampropeltis boylii** (B. & G.).
30. **Hypsiglena ochrorhynchus** Cope.
31. **Salvadora grahamiæ hexalepis** Cope.
32. **Pituophis catenifer** (Blainv.).
33. **Pituophis catenifer deserticola** Stejn.
34. **Bascanion flagellum frenatum** Stejn.
35. **Bascanion laterale** (Hallow.).
36. **Bascanion tæniatum** (Hallow.).
37. **Thamnophis infernalis** (Blainv.).
38. **Thamnophis elegans** (B. & G).
39. **Thamnophis hammondii** (Kenn.).
40. **Thamnophis vagrans** (B. & G).
41. **Thamnophis parietalis** (Say).

CROTALIDÆ.

42. **Crotalus tigris** Kenn.
43. **Crotalus cerastes** Hallow.
44. **Crotalus lucifer** B. & G.

B.—BATRACHIA.

Anura.

BUFONIDÆ.

45. **Bufo punctatus** B. & G.
46. **Bufo halophilus** B. & G.
47. **Bufo boreas nelsoni** Stejn.
48. **Bufo lentiginosus woodhousii** (Gir.).

SCAPHIOPODIDÆ.

49. **Scaphiopus hammondii** Baird.

HYLIDÆ.

50. **Hyla regilla** B. & G.

RANIDÆ.

51. **Rana draytonii** B. & G.
52. **Rana aurora** B. & G.
53. **Rana pretiosa** B. & G.
54. **Rana boylii** Baird.
55. **Rana fisheri** Stejn.
56. **Rana pipiens brachycephala** (Cope).

A.—REPTILIA.

Order I. TESTUDINES.

Family TESTUDINIDÆ.

Gopherus agassizii (Cooper).

The characters pointed out for this species by Mr. F. W. True (Proc. U. S. Nat. Mus. IV, p. 440) I have found to hold in the additional specimens before me, and there is no difficulty in distinguishing it from *Gopherus polyphemus*, much less from *G. berlandieri*. The fact that a specimen named *Xerobates berlandieri* (No. 10412) is recorded in Yarrow's Catalogue of Reptiles and Batrachians in the U. S. National Museum (Bull. U. S. Nat. Mus., No. 24, p. 38), as from Fort Yuma, Cal., need not disturb anybody, as it is in reality a *G. agassizii*, and is recorded as such by True (*tom. cit.*, p. 447).

This species was originally described "from the mountains of California, near Fort Mohave" (Cooper, Proc. Calif. Ac. Nat. Sc., II, p. 121), and the National Museum has since received specimens from Fort Yuma (exact locality ?). Dr. Cooper (*l. c.*) adds that "broken shells are frequent on the higher parts of the mountains west of the Colorado, where the Pah-Utes eat them."

The present expedition, therefore, not only extends the known range of this species considerably within California, but shows for the first time that it occurs in Nevada as well. The young one from Pahrump Valley has the carapace only 47^{mm} long, and the plastron is quite soft, while the length of the carapace collected at the Bend of the Colorado is no less than 290^{mm}.

[This tortoise is remarkable among American species for its power of living in the arid deserts of the Lower Sonoran zone, far away from water. It is tolerably common in the Mohave Desert, California, where one was caught between Daggett and Pilot Knob, April 24, and another at Leach Point Valley April 25. Two were found in Pahrump Valley, Nevada, where it is so much sought after by Pah-Ute Indians and coyotes that it is rather scarce. At the Great Bend of the Colorado many unusually large shells were found about an old Indian encampment, where they had been left after the bodies had been eaten.—C. H. M.]

List of specimens of Gopherus agassizii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18642	juv.	Pahrump Valley, Nev	....	Apr. 29	Bailey	Alcohol.
18643	ad.	......do	....	Mar. —	Fisher	Shell.
18644	ad.	Bend of Colorado River, Nev	....	May —	Merriam	Carapace.
18645	ad.	Daggett, Calif	....	Jan. 9	Fisher	Do.
19254	ad.	Leach Point Valley, Mohave Desert, Calif.	....	Apr. —	Bailey	Alcohol.

Clemmys marmorata (B. & G.).

The only specimen brought home by the expedition is a young one (No. 18641) collected by Dr. Fisher, July 5, in the South Fork of Kern River, 25 miles above Kernville, Calif. It is slightly smaller, but otherwise closely resembles Figs. 8 and 9, Pl. XXXII, in the atlas of the herpetology of the United States Exploring Expedition.

[Dr. A. K. Fisher obtained this turtle and saw many on the South Fork of Kern River, about 25 miles above Kernville, early in July, and Mr. Palmer and I saw half a dozen in a small pond 2 or 3 miles above the forks of the Kern June 25.—C. H. M.]

Order II. SQUAMATA.

Suborder I. *SAURI.*

Family EUBLEPHARIDÆ.

Coleonyx variegatus (Baird).

I am not prepared to unite most of the American species formerly referred to the genus *Coleonyx*, with the East Indian *Eublepharis* as recently proposed by Mr. Boulenger (Cat. Liz. Br. Mus., I, 1885, p. 230). The relative size of the claw sheaths is hardly of such importance as to justify a generic arrangement which would place the American forms in two genera, one of which would include the species found only in the East Indies. The presence or absence of enlarged chin shields seems to me a much more important character, and is far more satisfactory, since it effectually separates the American from the Indian species.

The three genera, by Boulenger referred to the family *Eublepharidæ*, would then stand thus:

Digits granular inferiorly	*Hemitheconyx* * (West Africa).	Enlarged chin shields.
Digits lamellar inferiorly	*Eublepharis* (Southern Asia).	Enlarged chin shields.
	Coleonyx (America).	No chin shields.

The genus *Coleonyx* would then contain four species, as follows:

a^1 Claw sheaths very large .... *Coleonyx elegans*
a^2 Claw sheaths small
  b^1 Back with enlarged tubercles .... *Coleonyx dovii*
  b^2 Back uniformly granular
    c^1 Snout elongate .... *Coleonyx variegatus*
    c^2 Snout short .... *Coleonyx brevis*

Boulenger (*l. c.*) recognizes two species of the *C. variegatus* type, one with the snout elongate, while in the other it is shortened. The former he gives a new name, *E. fasciatus*, and retains the name given by Baird for a specimen from Texas. It should be remarked that all his material consisted of two specimens, one from Texas, the other from Ventanas, Mexico.

I have examined twelve specimens with the result that there is an appreciable difference, as indicated by Boulenger, between five Texan specimens, on the one hand, and seven specimens from Arizona and California, on the other, and the latter agree so well with Boulenger's description of his *Eublepharis fasciatus* that I have no doubt about the identity of the Mexican specimen and those from Arizona and California. But it will be observed that Prof. Baird's type of *C. variegatus* came from the Colorado Desert, in southern California, and that consequently Boulenger's *E. fasciatus* is a synonym only, while it is the Texan form, with its short snout, less developed anterior nasals, and more numerous labials, which will have to be named. This form I would propose to call *Coleonyx brevis*.†

The synonymy of the two forms would then stand as follows:

Coleonyx variegatus.

1859. *Stenodactylus variegatus* Baird, Proc. Phila. Acad., 1858, p. 254 (type No. 3217, Colorado Desert). *Id.*, Mex. Bound. Surv. Rept., II, pp. 12, 34 (part), pl. XXIII, figs. 9–18 (type from Colorado Desert) and figs. 19–27 (male from Ft. Yuma, 1859).

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* *Hemitheconyx*, nom. nov., for *Psilodactylus* Gray, 1864, nec *Psilodactylus* Oken, 1816. Type *Hemitheconyx caudicinctus* (Dum.).

† Type, U. S. Nat. Mus., No. 13627; Helotes, Bexar Co., Texas; Marnock coll.

1866. *Coleonyx variegatus* Cope, Proc. Phila. Acad., 1866, p. 310. *Id., ibid.*, 1867 (p. 85) (Owens Valley, Calif.).
1885. *Eublepharis fasciatus* Boulenger, Cat. Liz. Br. Mus., I, p. 234 (Ventanas, Mexico).

Coleonyx brevis.

1859. *Stenodactylus variegatus* Baird, Mex. Bound. Surv. Rept. II, pp. 12–34 (part) pl. XXIV, figs. 11–19 (Jun. from Live Oak Creek, Texas).
1880. *Coleonyx variegatus* Cope, Bull. U. S. Nat. Mus., No. 17, p. 13 (Texas) (*nec* Baird).
1885. *Eublepharis variegatus* Boulenger, Cat. Liz. Br. Mus. I, p. 233 (Texas) (*nec* Baird).

The only specimen brought home by the expedition is a young one (No. 18620) collected by Mr. Bailey, January 23, on the east side of Death Valley, opposite Bennett Wells, about 50 feet above the salt flat. This is within the known range of this species, which extends east to Tucson, Ariz., north to Owens Valley, California, and west across the Colorado and Mohave Deserts to Mohave Station.

Family IGUANIDÆ.

Dipsosaurus dorsalis (B. & G.).

The sixteen specimens brought home by the expedition extend our knowledge of the geographical distribution of this species materially. We knew in a general way that it inhabits southern California and Lower California, but very few records of exact localities have ever been given. We now find that it occurs in the whole Death Valley region, extending north into Owens Valley, as high as 4,100 feet above the sea, and east to Callville, on the Great Bend of the Colorado, Nevada, making with the specimen from the Amargosa Desert, Nevada, the first record of the species in that State, so far as I know.

This species then ranges from Cape St. Lucas along the gulf coast of Lower California to the Colorado and Mohave deserts. To the east it extends at least as far as the Colorado River, but how far beyond is not known. Its northern range is indicated above.*

It is interesting to note that this species is a vegetable eater, as Dr. Merriam's subjoined notes show.

[This remarkable lizard, which in general form suggests the ancient Saurians, is more strictly limited to the torrid Lower Sonoran Zone than any other species, not excepting the gridiron-tail (*Callisaurus ventralis*). It ranges across the Lower Sonoran deserts of the Great Basin from the Mohave Desert and Death Valley to the Great Bend of the Colorado River, and thence northerly in eastern Nevada through the lower part of the valleys of the Virgin and Muddy, always keeping

* There is a record which would seem to indicate the occurrence of *Dipsosaurus dorsalis* on the west slope of the Sierra Nevada in California, inasmuch as the smaller specimen brought home by Dr. Heermann is said to have been collected between "Kern River and the Tejon Pass" (Pac. R. R. Rep., X, 1853, Williamson's route, p. 8), but it must not be forgotten that Lieut. Williamson's parties on that expedition were repeatedly on the slope toward the desert, and there is not the slightest probability that the specimen in question was collected on the valley slope.

within the *Larrea* belt. In western Nevada it reaches its northern limit in the Amargosa Desert, and was not found in Oasis Valley or Indian Spring Valley. In the northwest arm of Death Valley it does not range northward beyond Grapevine Cañon, and in Owens Valley was not found much north of the lake. It is a strict vegetarian, feeding on buds and flowers, which it devours in large quantities. No insects were found in any of the stomachs examined; some contained beautiful boquets of the yellow blossoms of acacia, the orange malvastrum, the rich purple Dalea, and the mesquite (*Prosopis juliflora*); others contained leaves only.—C. H. M.]

List of specimens of Dipsosaurus dorsalis

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18245	♂ ad.	Callville, Great Bend of Colorado, Nev.	....	May 4	Merriam....	
18246	juv.	......do	....	....do....	Bailey	
18247	juv.	......do	....	....do....	....do	
18248	ad.	Amargosa Desert, Nev.	....	May 31	Merriam....	
18249	juv.	Amargosa River, Calif.	....	Apr. 27	Bailey	
18250	juv.	......do	....	....do....	Merriam....	
18251	ad.	3 miles east of Owens Lake, Calif.	4,100	June 26	Bailey	
18252	ad.	Panamint Valley, Calif.	3,300	May 15	Nelson......	
18253	ad.	......do	....	Apr. 24	Bailey	
18254	ad.	Mohave Desert, Leach Point, Valley, Calif.	....	Apr. 25	Merriam....	
18255	ad.	Borax Flat Water Station, Calif.	2,100	Apr. 22	Stephens ...	
18256	ad.	Mesquite Valley, Calif.	....	Apr. 13	Bailey	
18257	ad.	Bennett Wells, Calif.	....	Apr. 1	....do	
18258	ad.	......do	....	Apr. 4	....do	
18259	juv.	Furnace Creek, Death Valley, Calif.	....	June 21	Fisher......	
18260	ad.	Owl Holes, Death Valley, Calif.	....	Apr. 26	Merriam....	

Crotaphytus baileyi Stejn.

The great number of specimens brought home by the expedition fully bear out the characters assigned by me in originally establishing this species (N. Am. Fauna, No. 3, 1890, p. 103).

When publishing the map (*op. cit.* Pl. XIII) showing localities from which specimens of *C. baileyi* and *collaris* had been examined, I was unable to point out any single definite locality in California, the only certain Californian specimen seen by me hailing from the 'Mohave Desert.' The specimens hereafter enumerated would fill quite a gap if plotted on that map.

In spite of the fact that this species, in certain localities at least, ascends the mountains as high as 5,600 feet, it does not occur anywhere within the interior valley of California, nor does it pass beyond the San Bernardino Range; in fact it does not seem to reach the coast anywhere; it is evidently an inland desert form.

[Bailey's ring-necked lizard does not inhabit the *Larrea* belt of the Lower Sonoran zone, but is common in suitable places in the Upper Sonoran, whence it descends a short distance into the *Grayia* belt. It lives among rocks, frequently in cañons, and is commonest in the desert ranges. In the Panamint Mountains, California, it was found in Surprise Cañon, in Emigrant Cañon just above the *Larrea* (altitude 1,400 meters, or 4,600 feet), and in the basin above Wild Rose Spring (at an altitude of 1,580 meters, or 5,200 feet). In the White Mountains it was secured in the cañon leading from Deep Spring Valley up over the pass (altitude 1,700 meters, or 5,600 feet), and also high up on the west slope, always among rocks; and Mr. Nelson collected it in the Inyo Mountains. Dr. Fisher and Mr. Palmer obtained specimens in the Argus Mountains and in Coso Valley. In Nevada it was rather common on the west slope of the Charleston Mountains below Mountain Spring, and was found also in Oasis Valley, at Quartz Spring at the west foot of the Desert Mountains (altitude 1,520 meters or 5,000 feet); in the Juniper Mountains along the boundary between Nevada and Utah (altitude 1,830–2,040 meters, 6,000–6,700 feet), and in the upper part of Pahranagat Valley.

In Utah, a very dark form was found in company with a black form of *Sceloporus biseriatus* on the black lava rock in Diamond Valley between St. George and the Upper Santa Clara crossing.—C. H. M.]

List of specimens of Crotaphytus baileyi.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18319	♂	Diamond Valley, Utah, 10 miles northwest of St. George.	4,800	May 16	Merriam....	On lava rock.
18320	♀	......do	4,800	....do ...	....do	Do.
18321	♀	......do	4,800	....do ...	....do	Do.
18322	♀ adol.	Oasis Valley, Nev	....	June 1	....do	
18323	♂	Desert Mountains, Quartz Spring, Nev.	5,000	May 28	....do	
18324	♂	Juniper Mountains (25 miles east of Panaca), Nev.	6,200	May 28	Bailey	In junipers.
18325	♂ adol.	North Kingston Mountains, Nev	....	April 28	....do	
18326	♂ adol.	......do	....	....do ...	....do	
18327	♂	White Mountains, Deep Spring Valley Slope, Calif.	5,600	June 9	Merriam....	
18328	♀	......do	5,600	....do ...	....do	
18329	♂	Emigrant Cañon, Calif., Panamint Mountains.	4 600	....do ...	Stephens ... Nelson......	
18330	♂	Inyo Mountains, Calif	5,000	May 17		
18331	♀	Death Valley, 5 miles from Bennett Wells, Calif	....	Mar. 25	Fisher......	
18332	♂	Coso Valley, near Maturango Spring, Calif.	....	May 11	Palmer	
18333	♂	Argus Range, Shepherd Cañon, Calif.	....	April 27	Fisher......	
18334	♀	......do	....	....do ...	....do	
18335	♀	......do	....	....do ...	....do	
18336	♂	Argus Range, Maturango Spring, Calif.	....	May 3	....do	
18337	♂	Argus Range, Searl's Garden, Calif...	2,000	April 28	Stephens ...	
18338	♂	Panamint Mountains, Willow Creek, Calif.	4,500	May 19	Nelson......	
18339	♂ adol.	......do	4,500	....do ...	....do	
18340	♀ adol.	......do	4,500	....do ...	....do	
18341	♀ adol.	Panamint Mountains, Mill Creek Calif.	4,900	May 15	....do	
18342	♂ adol.	Panamint Mountains, Surprise Cañon, Calif.	....	April 23	Fisher......	
18343	♂	Panamint Mountains, 3 miles above Wild Rose Spring, Calif.	5,000	April 16	Stephens ...	
18344	♂	......do	5,000	....do ...	....do.	

Crotaphytus wislizenii B. & G.

Evidently one of the commonest lizards in all the desert localities visited by members of the expedition, as the subjoined list of specimens will show. The relative distribution of this species, as compared with *C. silus*, will be discussed under the latter.

Some of the females when received showed strong traces on the under side, particularly on the tail, of a vivid scarlet color, which had a very curious superficial appearance, as if caused by loosely adherent particles of dry color. It has faded entirely out of all the specimens in alcohol. Dr. Merriam has recorded detailed observations on this point in the accompanying note.

The ferocity and greed of this species is well illustrated by several of the specimens caught. Thus the stomach of a young male (No. 18291) was found to contain two full-grown lizards, *Uta stansburiana*, while an adult female (No. 18276) when opened gave up one full-grown horned-toad, *Phrynosoma platyrhinos*, besides remnants of a grown specimen of her own species!

[The leopard lizard is abundant in most, if not all, of the Lower Sonoran deserts of the Great Basin from southern California eastward across southern Nevada to Arizona and southwestern Utah. While properly belonging to the Lower Sonoran zone, it ranges up a certain distance into the Upper Sonoran, occurring further north and higher on the mountain sides than either *Callisaurus* or *Dipsosaurus*, and usually a little higher even than *Cnemidophorus*.

It was found in abundance in all of the Lower Sonoran deserts traversed, from the Mohave Desert, Panamint and Death Valleys, Ash Meadows, the Amargosa Desert, Indian Spring, Pahrump, and Vegas valleys to the Great Bend of the Colorado, and thence northerly through the valleys of the Virgin and Muddy across the northwest corner of Arizona to the Santa Clara Valley in Utah, and Pahranagat and Meadow Creek Valleys in Nevada. The upper limit of its range was not reached except in a few places, as indicated by the following localities: It was abundant throughout Antelope Valley, at the extreme west end of the Mohave Desert, ranging thence northerly through the wash or open cañon leading to Tehachapi Valley. (It was not seen in Tehachapi Valley, which is not strange, as a sharp, cold wind blew the only day we were there.) It ranges completely over Walker Pass (altitude of divide 1,550 meters, or 5,100 feet) and is common in Owens Valley, ranging as far north at least as Bishop Creek, and as high as 1,980 meters (6,500 feet) along the west slope of the White and Inyo Mountains (opposite Big Pine). On the east side of the White Mountains it is common in Deep Spring and Fish Lake valleys, and was found on the northwest slope of Mount Magruder (below Pigeon Spring) as high as 1,980 meters (6,500 feet). It was seen at the same elevation in Tule Cañon, but does not reach the Mount Magruder plateau (altitude about 2,450 meters, or 8,000 feet). Coming up through Grapevine Cañon from the northwest arm of Death Valley it spreads over Sarcobatus Flat, and ascends the south slope of Gold Mountain a little higher than the creosote bush (*Larrea*), which stops at about 1,640 meters (or 5,400 feet) on the most favorable southwest exposures. It is common in Oasis Valley (coming in from both Sarcobatus Flat and the Amargosa Desert), and doubtless ranges over most of the Ralston Desert. It was found on the Desert. Timpahute and Pahranagat Mountains, as well as the intervening deserts, and on Pahroc Plain, and thence easterly across Meadow Creek Valley and the Juniper Mountain plateau (along the boundary between Nevada and Utah) to the Escalante Desert in Utah, and thence southerly through the sage brush to Mountain Meadows and the Santa Clara Valley. It was common on the Argus and Panamint mountains, and on the latter was taken as high as 1,610 meters (5,300 feet) near Wild Rose Spring, and may range higher.

Crotaphytus wislizenii, in company with two other Great Basin lizards (*Cnemidophorus tigris* and *Uta stansburiana*), two desert birds (*Harporhynchus lecontei* and *Campylorhynchus brunneicapillus*), the antelope or white-tailed squirrel (*Spermophilus leucurus*), and a number of desert plants (among which may be mentioned the tree yucca, *Yucca arborescens*, *Tetradymia spinosa*, *T. comosa*, *Lycium andersoni*, *L. cooperi*, *Hymenoclea salsola*, *Eriogonum fasciculatum*, and *Ephedra nevadensis*) passes over the low summit of Walker Pass (altitude 1,550 meters, or 5,100 feet), and descends westerly to Kern Valley on the west slope of the Sierra. From Kern Valley *Crotaphytus wislizenii* ranges southward to Havilah, if not to Walker Basin.

The leopard lizard is chiefly a vegetarian, feeding on the blossoms and leaves of plants; but is also carnivorous, devouring the smaller lizards, horned toads, and even its own kind, besides large numbers of insects, as determined by the examination of many stomachs. In the Argus Range Dr. Fisher surprised one in the act of swallowing a scaly lizard (*Sceloporus*) two-thirds its own size.

In many lizards, as well known, the male assumes a special coloration during the breeding season. The present species is a notable exception, the male remaining the same, while the female undergoes a remarkable change. The whole under surface and sides of the tail become deep salmon or even salmon red, and the sides of the body assume the same color, either uniformly or in blotches. The red markings on the sides usually begin as spots, which soon unite to form transverse stripes. The central part of the back is not affected by the change, and the dark markings on the sides remain distinct. None were seen in this condition until May 20, when the first red one was found on Pahroc Plain, Nev., but dozens were seen afterward in Pahranagat Valley, Indian Spring Valley, the Armagosa Desert, Tule Cañon, and numerous other localities. The change does not take place till late in the development of the egg. Many pairs were observed in copulation in ·ond and the Upper Santa Clara Valleys, Utah, and thence northward to Mountain Meadows and the Escalante Desert, and westerly across the Juniper Mountains to Meadow Creek Valley from May 17 to 19, but no trace of the red coloration had appeared. The red individuals were always found to contain large eggs, generally measuring from 12 to 15^{mm} in length, with the coriaceous shell already formed.—C. H. M.]

List of specimens of Crotaphytus wislizenii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18258	♂	St. George, Utah		May 13	Bailey	
18259	♂	10 miles northwest of St. George, Utah	4,800	May 16	do	
18260	♂	Mountain Meadows, Utah		May 17	Merriam	
18261	♀	do		do	do	
18262	♀	do		do	do	
18263	♀	do		do	do	
18264	♀	Panaca, Nev		May 19	Bailey	
18265	♂	Vegas Valley, Nev		May 2	do	
18266	♀	Tule Cañon, Mount Magruder, Nev		June 5	Merriam	
18267	♂	Quartz Spring, Nev		May 28	do	
18268	♂	Amargosa Desert, Nev		May 31	do	
18269	♂	Sarcobatus Flat, Nev	4,600	June 2	Bailey	
18270	♀	East foot of Charleston Mountains (Cottonwood Springs), Nev.	4,800	Apr. 30	do	
18271	♀	Grapevine Mountains, Nev	4,800	June 10	Nelson	
18272	♂	Timpahute Mountains, Nev		May 26	Bailey	
18273	♀	do		do	do	
18274	♀	Indian Spring Valley, Nev		May 28	Merriam	
18275	♀	do		May 29	do	
18276	♀	Pahrump Valley, Nev		Apr. 29	Bailey	
18277	♂	do		do	do	
18278	♂	do		Apr. 28	Merriam	
18279	♂	Pahranagat Valley, Nev		May 23	Bailey	
18280	♀	do		May 25	do	
18281	♀	Pahranagat Mountains, Nev		May 26	Merriam	
18282	♀	Oasis Valley, Nev		June 1	do	
18283	♂	Darwin, Calif		May 29	Palmer	
18284	♂	Panamint Valley, Calif		Apr. 24	Merriam	
18285	♂	Panamint Mountains, Wild Rose Spring, Calif.	5,300	Apr. 16	Bailey	
18286	♂ jun.	do	5,360	do	do	
18287	♂	Panamint Mountains, Cottonwood Cañon, Calif.	4,900	May 26	Nelson	
18288	♀ jun.	do	6,200	do	do	
18289	♀	do		June 14	do	3,900 feet above Salt Wells.
18290	♂ jun.	Garlick Spring, Calif		Mar. 14	Palmer	
18291	♂ jun.	Death Valley (Saratoga Spring) Calif.		Mar. 8	do	
18292	♂	Argus Range, Shepherd Cañon, Calif		Apr. 28	Fisher	
18293	♀	Owens Valley, Independence, Calif		June 14	Palmer	
18294	♂	Mohave Desert, Southern Pacific Railroad, Calif., 2 miles below Cameron.		June 26	Merriam	
18295	♂	Mohave Desert, 15 miles east of Mohave, Calif.		Sept. 11	Stephens	
18296	♂	Mohave Desert, north base of Granite Mountain, Calif.		Apr. 5	Merriam	
18297	♂	Havilah, Calif		June 24	do	
[illegible]	♂	Kernville, Calif		June 23	Palmer	
[illegible]	♀	Colorado Desert, Palm Spring, Calif		Sept. 27	Stephens	
[illegible]	♀	Coso, Calif		May 28	Fisher	
[illegible]	♂ jun.	do		May 19	Palmer	
[illegible]	♂	Panamint Mountains (Emigrant Spring), Calif.	4,400	Apr. 14	Bailey	
[illegible]	♀	Saline Valley, Calif	4,600	June 30	Nelson	
[illegible]	♀ jun.	do	2,300	May 22	do	
[illegible]	♀	Owens Valley, 20 miles west of Bishop, Calif.	4,500	July 3	Stephens	
[illegible]	♂	Lone Pine, Calif		June 8	Fisher	
[illegible]	♀	do		June 5	do	
[illegible]	♂	do		do	Palmer	
[illegible]	♀	do		June 6	do	

Crotraphytus silus Stejn.

Nine additional specimens from the San Joaquin Valley confirm the distinctness of this species.

In addition to the very strongly marked proportional differences in the head pointed out in the original description (N. Am. Fauna, No. 3, p. 105,) it is now found that the coloration is also essentially different. In *C. silus* the rounded dorsal spots are larger, especially the two median rows, so that of the latter there is only one longitudinal series between the light cross-bands. The latter are very broad and distinct and do not seem to disappear as the animal grows larger. In some specimens the interspaces between the light bands are solidly dark, the spots indicated only by somewhat ill-defined patches of saturated ferrugineous.

This species seems to be closely restricted to the San Joaquin Valley, while the typical *C. wislizenii* reaches the west slope of the Sierra Nevada through Walker Pass, the summit of which is only 5,100 feet in altitude and, therefore, not above the vertical range of the species. This fact is demonstrated by two specimens brought home by the expedition, viz, No. 18298 which was collected by Mr. Palmer at Kernville, June 23, and No. 18297 collected by Dr. Merriam at Havilah, June 24. Kernville and Havilah are on the west slope of the Sierra, and the specimens from both are undoubted *C. wislizenii* both as to proportions and coloration. If we were ever to find intermediate forms between the two species, specimens from these localities would be expected to furnish them, but it is a significant fact that they are as typical as any of the specimens collected outside of the great interior valley of California.

List of specimens of Crotaphytus silus.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18310	♂	Tejon Ranch, Calif.		July 13	Palmer	
18311	♂	5 miles north of Rose Station, Calif.		Oct. 13	Nelson	
18312	♂	do.		do	do	
18313	♀ juv.	Poso, Calif.		Oct. 10	do	
18314	♂ juv.	Bakersfield, Calif.		July 17	Bailey	
18315	♀ juv.	do		Oct. 11	Nelson	
18316	♂ juv.	do		do	do	
18317	♀ juv.	do		do	do	
18318	♀	Pampa, Calif.		July 16	Bailey	

Callisaurus ventralis (Hallow.).

The large series of this interesting species brought home by the expedition has not only filled up gaps in our knowledge of its distribution, but has also afforded enough material to decide beyond a doubt the question as to the specific difference between the present form and typical *Callisaurus draconoides* Blainv. The differences are numerous and are found both in structure and coloration. Moreover, after an examination of about 200 specimens I can affirm that the characters are constant and that the two forms do not intergrade. That Boulenger (Cat. Liz. Br. Mus., II, 1885, p. 206) failed to appreciate the difference is probably due to the fact that he had only two specimens of one species, probably *C. ventralis*, before him.

As to the geographical distribution of the two species it may be stated that *C. draconoides* is restricted to the very southern extremity of the Lower California peninsula—that is, to the zoo-geographical district which has been termed the Cape Region, or Cape St. Lucas Region.

While this species, therefore, is of a very limited range, *C. ventralis* ranges over a comparatively large area, comprising, so far as known, the northern portion of Lower California; the coast of Sonora, Mexico, at least as far south as Guaymas; the desert regions of southern California; southern Arizona as far east as Camp Apache and Fort Buchanan, at least; southern and western Nevada as far north as Pyramid Lake; southern Utah, where it is restricted to the Lower Santa Clara Valley.*

It can be asserted with confidence that *Callisaurus ventralis* does not occur anywhere within the interior valley of California, not even in Walker Basin. Nor is there any evidence to show that it occurs anywhere southwest of the San Bernardino range, within the boundary of the State of California.

[The gridiron-tailed lizard is the most characteristic reptile of the Lower Sonoran deserts of southern California, southern Nevada, southwestern Utah, and Arizona, where it is almost universally distributed and very much more abundant than any other species. It inhabits the open deserts and runs with great swiftness over the sand and gravel beds, carrying its tail curled up over its back as if afraid to let it touch the hot surface of the earth. It starts off at full speed, as if fired from a cannon, and stops with equal suddenness, thus escaping or eluding its enemies, the coyotes, hawks, and larger lizards. When running it moves so swiftly that the eye has difficulty in following, and when at rest its colors harmonize so well with those of the desert that it can hardly be seen. The basal half of its tail is transversely barred underneath, and the bars are broad and distant, suggesting the name here applied to the species in lieu of a better one. During the breeding season the males develop a conspicuous patch of metallic greenish-blue on the sides of the body and have the power of inflating a pinkish sac under the chin.

The attitude of this lizard when at rest differs from that of most others in that the knees and elbows stand out at right angles from the body and are elevated to such a degree that they nearly reach the plane of the back. Like many other species, it has an odd habit of per-

*Some authors even include Texas in the geographical distribution of this species (and genus), but with no foundation in facts. I am not aware of an authentic record of its having been collected in New Mexico. The type came from what was then 'New Mexico,' but in those days that included Arizona as well.

forming a singular gymnastic exercise, consisting in rapidly dropping and elevating the body with the knees held stiff at right angles to the trunk.

This species feeds on insects and the blossoms and leaves of plants in about equal proportion; at least such was the case in the large number whose stomachs were examined.

The gridiron-tailed lizard is common throughout the Mohave Desert proper, but does not reach the extreme western end of the desert in Antelope Valley, which, owing to its greater altitude, passes out of the Lower Sonoran zone. It was last seen in this direction about 10 miles east of Liebre ranch. In the wash leading from the Mohave Desert to Tehachapi Valley it was seen up to 1,030 meters (3,400 feet) and may range higher. It is common in the Lower Sonoran zone at the south end of Owens Valley, and ranges up on the warm east side of the valley as far as Big Pine. It is common throughout Panamint and Death valleys and in the Amargosa Desert. In Nevada it inhabits the deserts of the southern part of the State, from Ash Meadows easterly across Pahrump and Vegas valleys to the Great Bend of the Colorado, where it is very common, and ranges north through the valleys of the Virgin and Lower Muddy (where it is abundant) to Pahranagat and Meadow Creek valleys. In western Nevada it comes through Grapevine Cañon (from the northwest arm of Death Valley), ranges easterly over Sarcobatus Flat, and ascends the warm south slope of Gold Mountain, with *Larrea*, to about 1,640 meters (5,400 feet). In Utah it is common in the Lower Santa Clara Valley, but does not range up into the sage-brush or Upper Sonoran Zone of the upper part of the valley.

In Desert Valley, just east of the Pahroc Mountains, a form of this species was found which seems to be subspecifically distinct from the ordinary type. It is much shorter and broader, with a shorter tail, and is bluish-gray in color. It may be the same as the animal inhabiting the desert at Pyramid Lake, Nevada, which point is about two degrees further north than Desert Valley, though in the same zoölogical subzone, for the low altitude of a series of narrow and irregular deserts in western Nevada carries this zone much further north than elsewhere. These specimens suggest the existence of a form peculiar to the upper division (or *Grayia* belt) of the Lower Sonoran Zone, *Callisaurus ventralis* proper being closely restricted to the lower division (or *Larrea* belt) of the same zone.—C. H. M.]

List of specimens of Callisaurus ventralis.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	♂	Death Valley (Bennett Wells) Calif		Apr. 4	Bailey	
[illegible]	♀	do		Apr. 1	do	
[illegible]	♀	do		Apr. 4	do	
[illegible]	♀	do		Jan. 22	do	
[illegible]	♂	do		Apr. —	do	
[illegible]	♂	do		Mar. 22	Nelson	
[illegible]	♂	do		Jan. 20	do	
[illegible]	♀	Death Valley, Furnace Creek, Calif		June 20	Fisher	
[illegible]	♀	Argus Range, Shepherd Cañon, Calif		Apr. 27	do	
[illegible]	♂	Panamint Valley, Calif		Apr. 24	Merriam	
[illegible]	♂	do		do	do	
[illegible]	♂	do		do	Fisher	
[illegible]	♂	do		do	Bailey	
[illegible]	♀	do		do	do	
[illegible]	♂ juv.	do		do	do	
[illegible]	♂	Death Valley (Saratoga Springs), Calif.		Mar. 8	Palmer	
[illegible]	♂	do		do	do	
[illegible]	♂ juv.	do		Feb. 2	Bailey	
[illegible]	♂ juv.	do		do	do	
[illegible]	♀	Owens Lake, Olancha, Calif	3,700	May 19?	Stephens	
[illegible]	♂	Water Station, Borax Flat, Calif	2,200	Apr. 22	do	
[illegible]	♂	Garlick Springs, Calif		Mar. 14	Palmer	
[illegible]	♂	Panamint Mountains (Emigrant Spring), Calif.		Apr. 14	Bailey	
[illegible]	♂ juv.	do		do	do	
[illegible]	♂ juv.	Funeral Mountains, Calif		Feb. 6	Nelson	
[illegible]	♀ juv.	do		do	do	
[illegible]	♀	Owens Valley (Lone Pine), Calif		June 6	Palmer	
[illegible]	♂	Cameron, 8 miles northwest Mohave, Calif.		June 26	do	
[illegible]	♂	Saline Valley, Calif	2,500	Jan. 30	Nelson	
[illegible]	♂	Sarcobatus Flat, Nev	4,400	June 2	Merriam	
[illegible]	♂	do	4,600	do	Bailey	
[illegible]	♂	Amargosa River, Nev		Mar. 21	Fisher	
[illegible]	♀	do		do	do	
[illegible]	♂ juv.	Amargosa River, Calif		Apr. 27	Bailey	
[illegible]	♂	Ash Meadows, Nev		Mar. 20	Fisher	
[illegible]	♂ juv.	do		Mar. 18	do	
[illegible]	♂ juv.	do		Mar. 4	Nelson	
[illegible]	♀ juv.	do		do	do	
[illegible]	♂	Great Bend of Colorado (Callville), Nev		May 4	do	
[illegible]	♂	do		do	do	
[illegible]	♀	do		do	do	
[illegible]	♀ ad.	do		do	do	
[illegible]	♂	Pahranagat Valley, Nev		May 23	Bailey	
[illegible]	♂	do		do	do	
[illegible]	♂	do		do	Merriam	
[illegible]	♀ ad.	do		do	do	
[illegible]	♂ juv.	do		do	do	
[illegible]	♂	Pahrump Valley, Nev		Apr. 29	Bailey	
[illegible]	♀	do		do	Merriam	
[illegible]	♀	Desert Valley, Nev	5,300	May 21	do	
[illegible]	♀	Gold Mountain, Nev	6,000	June 3	Bailey	
[illegible]	♀	Mohave Desert, Calif., Leach Point Valley.		Apr. 25	do	
[illegible]	♀ juv.	do		do	do	

Sauromalus ater Dum. (Pl. 1y).

It is quite gratifying to find in the large series of this species collected by the expedition all the diagnostic characters verified, which I indicated at the time I separated the large *Sauromalus hispidus* from the present species (Proc. U. S. Nat. Mus., XIV, 1891, pp. 409–411). This series also fully confirms my assumption that the largest of the specimens then at my command were fully adult. Some of the specimens of the Death Valley Expedition are somewhat larger than the largest specimens heretofore recorded, measuring in total length 415 mm and over (exact length not ascertainable as the tip of the tail of the largest specimen had evidently been lost by the animal when alive), and yet there is no approach whatever towards the distinctive characters of *S. hispidus*.

There is great individual variation in the coloration of this species, especially in the amount of black on the lower parts and in the dark cross bars on the upper surface, and although the latter are particularly well developed and defined in the young specimens, several of the older ones are by no means deficient in this respect. It is a curious fact, however, that the distinctness—or even the presence or absence—of these cross bars, especially on the tail, is changeable in the same individual and apparently dependent upon the intensity of the light to which the animal is exposed, an observation which I was able to make on a specimen which was sent to Washington alive.

I am informed that observations in the field show this species to be a vegetable eater as has already been demonstrated for the *S. hispidus*.

Beyond rather vague statements as to the general distribution of the present species very little exact information in regard to its range has been published. It is evident that the localities from which the expedition brought home its specimens—almost four times as many as in any museum before—form the center of the geographical range of the 'chuck walla.' From here it extends southward along the Colorado River for an unknown distance, ranging westward into the Colorado Desert, and eastward along the Gila into Arizona. Dr. Merriam has now for the first time definitely demonstrated its occurrence in southern Nevada and southwestern Utah.

The 'chuck walla,' by which name this remarkable lizard is universally known to both Indians and whites (except the Mormons), inhabits many of the Lower Sonoran Desert ranges in the southern part of the Great Basin from the Mohave and Colorado Deserts easterly across southern Nevada to Arizona, and north to the southwestern corner of Utah. It is the largest lizard of the desert region except the Gila monster (*Heloderma*), which only slightly exceeds it in size. The broad body is black or blackish, and the large blunt tail is usually marbled with white or entirely white. It was generally found on lava or other dark rocks with which its coloration harmonizes. It is a vegetarian, feeding entirely, so far as our observations go, on the buds and flowers of plants, with the addition sometimes of a few leaves. It is much prized by the Panamint Indians as an article of food. A number were eaten by members of our expedition, and their flesh was reported to be tender and palatable.

Specimens were secured in the Panamint Range, the Amargosa Cañon, on a lava knoll on the west side of Pahrump Valley, Calif., and in the Lower Santa Clara Valley in Utah. In the latter locality, they are common both along the cañon of the Lower Santa Clara and among the red sandstone cliffs near the village of St. George, and are called 'alligators' by the Mormons. Dr. Fisher found them in considerable numbers in the

Argus Range, west of Panamint Valley, and examined a number of stomachs, in which he found the following plants (either flowers or foliage or both): *Dalea fremontii*, *Leptosyne bigelovii*, *Amsinckia tessellata*, *Lotus*, *Sphæralcea munroana*, and *Ephedra viridis*.—C. H. M.]

List of specimens of Sauromalus ater.

U.S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	♂	Santa Clara Cañon, Utah	....	May 11	Bailey	
[illegible]	♂	St. George, Utah	3,000	May 13	Merriam	
[illegible]	♀ ad.	do		May 14	do	
[illegible]	ad.	Pahrump Valley, Nev		Apr. 28	do	
[illegible]	ad.	Amargosa River, Calif		Apr. 27	do	
[illegible]	ad.	Lookout, Inyo County, Calif		Mar. 27	Bailey	
[illegible]	juv.	Death Valley, Furnace Creek, Calif		Mar. 22	Fisher	
[illegible]	♂	Panamint Mountains, Willow Creek, Calif.	4,500	May 19	Nelson	
[illegible]	ad.	do		Apr. 21	Coville	
[illegible]	♂	Argus Range, Shepherd Cañon, Calif		Apr. 29	Fisher	
[illegible]	♂	do		do	do	
[illegible]	♀	do		do	do	
[illegible]	♂	do		Apr. 26	do	
[illegible]	♀	do		Apr. 23	do	
[illegible]	ad.	do			do	Skin.
[illegible]	ad.	do		Apr. —	do	
[illegible]	ad.	do		Apr. —	do	
[illegible]	ad.	do		Apr. —	do	

Uta stansburiana B. & G.

The regions visited by the expedition falling within the known range of this species one can hardly wonder at the magnificent series sent home.

With the material already at hand it should now be possible to settle all questions as to individual and geographical variation within the species. The task of handling this material, however, is too great to be attempted in the present connection and must be reserved for some future occasion.

[This tiny brown-shouldered lizard is common over nearly the whole of the desert region traversed by the expedition, from California to Utah and Arizona and occurs also on the west slope of the Sierra Nevada, as the subjoined list of localities shows. Whether the form inhabiting the upper San Joaquin Valley is identical with that from the deserts of the Great Basin remains to be seen.

Uta stansburiana is common throughout the Mohave Desert, ranging westward to the extreme west end of Antelope Valley and down through the Cañada de las Uvas to Old Fort Tejon. It ranges also over Walker Pass and down into Kern Valley. It is common in Owens Valley, and thence easterly in the Coso Mountains, Panamint Valley and Mountains, Death Valley, the Amargosa Desert, Ash Meadows, Pahrump and Vegas Valleys, and at the Great Bend of the Colorado, whence it ranges northerly in the valleys of the Virgin and Muddy to the Santa Clara Valley in southwestern Utah, and Pahranagat Valley, Nevada. In western Nevada it was not found north of Sarcobatus Flat.—C. H. M.]

List of specimens of Uta stansburiana.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18508	♂	St. George, Utah	3,000	May 13	Bailey	
18509	♂	do		do	do	
18510	♂	do		do	Merriam	
18511	♀	do		May 14	do	
18512	♀	do		do	do	
18513	♀	do		May 13	do	
18514	♀	do		do	Bailey	
18515	♀	do		do	do	
18516	♀	do		do	do	
18517	♂	Virgin River, Nev		May 6	do	
18518	♂	Charleston Mountains, Mountain Spring, Nev.	5,600	Apr. 30	Merriam	
18519	♀	do	5,600	do	do	
18520	♂	Pahrump Valley, Nev		Feb. 19	Nelson	
18521	♂	do		Feb. 26	Palmer	
18522	♂	do		Apr. 28	Merriam	
18523	♀	do		Apr. 29	Bailey	
18524	♂	Pahranagat Valley, Nev		May 23	Merriam	
18525	♂	Vegas Valley, Nev	1,900	Mar. 12	Bailey	
18526	♀	do	1,930	do	do	
18527	♂	Ash Meadows, Nev		Mar. 2	Nelson	
18528	♂	do		Mar. 4	do	
18529	♀	do		Mar. 17	do	
18530	♂	do		Mar. 13	Fisher	
18531	♂ im.	do		Mar. 14	do	
18532	♀	do		Mar. 19	do	
18533	♀	do		Mar. 11	do	
18534	♀	do		Mar. 13	do	
18535	♀	do		Mar. 2	Stephens	
18536	♀ juv.	do		do	do	
18537	♂	Death Valley, Calif		Jan. 23	Bailey	
18538	♀	do		do	do	
18539	♂	do		Mar. 22	Nelson	
18540	♂	do		do	do	
18541	♀	Death Valley, near Salt Wells, Calif		Jan. 29	Bailey	
18542	♂	Death Valley, Bennett Wells, Calif		Jan. 21	Palmer	
18543	♂	do		do	do	
18544	♂	do		do	Fisher	
18545	♂	do		do	do	
18546	♂	do		do	do	
18547	♂	do		Jan. 22	Nelson	
18548	♂	do		Jan. 24	do	
18549	♂	do		Jan. 26	do	
18550	♂	do		do	do	
18551	♀	do		do	do	
18552	♀	do		Jan. 28	Bailey	
18553	♀	do		Apr. 28	do	
18554	♂	Death Valley, Mesquite Well, Calif		Jan. 20	Fisher	
18555	♀	do		do	do	
18556	♂	Death Valley, Furnace Creek, Calif		Feb. 1	Palmer	
18557	♂	do		Jan. 26	do	
18558	♂	do		Jan. 24	do	
18559	♂	do		Jan. 23	Fisher	
18560	♂	do		Jan. 30	do	
18561	♀	do		Apr. 10	Stephens	
18562	♀	Funeral Mountains, Calif		Feb. 6	Nelson	
18563	♀	do		do	do	
18564	♂	Death Valley, Saratoga Springs, Calif.		Feb. 3	Bailey	
18565	♂	do		Jan. 30	do	
18566	♂	do		do	do	
18567	♀	do		do	do	
18568	♀	do		Feb. 2	Nelson	
18569	♂	do		do	do	
18570	♀	Resting Springs, Calif		Feb. 13	Fisher	
18571	ad.	Borax Flat, Water Station, Calif	2,100	Apr. 22	Stephens	
18572	♂	Panamint Mountains, Johnson Cañon, Calif.		Mar. 30	Fisher	
18573	♂	do		do	do	
18574	♀	do	5,000	Mar. 28	do	
18575	♀	do	5,560	Apr. 3	Nelson	
18576	♂	do	6,000	Mar. 31	do	

List of specimens of Uta stansburiana—Continued.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
15577	♂	Panamint Valley, Calif.		Jan. 5	Bailey	
15578	♂	......do	1,575	Jan. 12	....do	
15579	♂	......do	1,575	...do	....do	
15580	♀	......do		Jan. 5	....do	
15581	♀	......do		Apr. 20	....do	
15582	♂	Coso Mountains, Coso, Calif.		May 22	Fisher	
15583	♀	Panamint Mountains, Emigrant Spring, Calif.		Apr. 14	Bailey	
15584	♂	Mohave Desert, Leach Point Spring, Calif.		Apr. 25	....do	
15585	♀	Keeler, Calif.		June 3	Fisher	
15586	♂	Fort Tejon, Calif.		June 28	Merriam	
15587	♂	......do		...do	....do	
15588	♀	Antelope Valley, Liebré Ranch, Calif.		...do	....do	
15589	♂	Walker Pass (west slope), Calif.	4,600	July 3	Bailey	
15590	♂	Roses Station, Calif.		Oct. 13	Nelson	
15591	♂	Kernville, Calif.		June 23	Palmer	
15592	♂	......do		...do	....do	
15593	♂	Kern River, South Fork, Calif.	2,700	July 9	Bailey	
15594	♂	Fresno, Calif.		Sep. 23	....do	
15595	♂	......do		...do	....do	
15596	♂	Lone Pine, Calif.	7,000	Dec. 19	....do	Lone Pine Cañon.
15597	♂	Caliente, Calif.		June 24	Palmer	

Uta graciosa (Hallow.).

The known range of this well-named species has been considerably extended by the few specimens brought home by Dr. Merriam, inasmuch as it carries it into Nevada, the first record for that State.

Uta graciosa has a very peculiar and considerably restricted distribution, for the only definite localities so far recorded show it to be an inhabitant of a narrow strip of country on both sides of the Colorado River, probably from its mouth up to the beginning of the Great Cañon, and, as now shown, some distance up the Virgin River.

[This slender and agile lizard was not seen in any of the deserts of southern California or Nevada, except in extreme eastern Nevada, where it was common at the Great Bend of the Colorado; thence northward it was found in a few places in the valley of the Virgin as far north as the Mormon town of Bunkerville, a few miles from the northwestern corner of Arizona. It was never seen on the open desert but usually on mesquite trees and the faces of cliffs, over which it moves with grace and agility.—C. H. M.]

List of specimens of Uta graciosa.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
15505	♂	Bunkerville, Nev.		May 8	Bailey	
15506	♂	Callville, Nev. (Great Bend of Colorado).		May 4	Merriam	
15507	♂	......do		...do	....do	

Sceloporus magister (Hallow.). (Pl. I, fig. 2.).

The curious fate of *Sceloporus marmoratus*, or *variabilis*, in herpetological literature, as recently pointed out by me (Proc. U. S. Nat. Mus., XIV, 1891, p. 485, *seq.*), is equaled, if not surpassed, by that of the present species and *Sceloporus clarkii.*

The latter species was established in 1852 by Baird and Girard upon specimens from 'Sonora' (*i. e.*, Arizona). Two years later, Mr. Hallowell described another large specimen of *Sceloporus* from the vicinity of Fort Yuma as *S. magister.* With the material at hand then, and considering the insufficiency of the descriptions, it is hardly to be wondered at that Baird and Girard subsequently adduced Hallowell's name *S. magister* as a synonym to *S. clarkii*, or that they have been followed in this course by all subsequent herpetologists, with the possible exception, perhaps, of Hallowell himself, who, in 1859 still retains the name *S. magister.* They are, however, undoubtedly good species, as will be shown further on.

One of the more recent authors to monograph the genus, Mr. Bocourt, in 1874, seems to have recognized the difference between the two, as he thinks *S. clarkii* related to *S. formosus*, and *S. magister* to *spinosus* or *acanthinus*, but beyond these vague suggestions, there is nothing to indicate that he ever had the opportunity to examine specimens of either.

In 1875 *S. clarkii* is recognized by Cope, Coues, and Yarrow, in their various publications, and *zosteromus* is made a subspecies of *S. clarkii*, but not even that much recognition is given *S. magister.* In Yarrow's Catalogue and Check list of 1883 there is no change.

In Cope's 'Synopsis of the Mexican Species of the Genus *Sceloporus*,' published in 1885, there is a decided inclination towards lumping several of the North American forms (see for instance the synonymy of *S. undulatus*), but one is hardly prepared to find *S. zosteromus* raised to a distinct species again and to the total abandonment of *S. clarkii.* True, the paper by its title refers only to Mexican species, but as it includes several species confined to the United States it seems evident that the species occurring in North America were also intended to be included.

But in the same year we meet a decided novelty, as Mr. Boulenger, in the second volume of his Catalogue of the Lizards in the British Museum, makes *S. clarkii* a subspecies of *S. spinosus*, with the following synonymy: *S. magister* Hall.; *S. floridanus* Baird, and *S. thayerii* Bocourt (*nec.* B.& G.)! And in addition he remarks: "This form appears to be completely linked with *S. undulatus.*" Before proceeding further I will note here that at least his specimen *a*, from the 'Colorado Bottom,' is true *S. magister*, and that possibly he has not seen *S. clarkii*, under which name this specimen was probably sent to the British Museum by the Smithsonian Institution.

The last monographer of the genus, Dr. Günther, in the reptile volume of Biologia Centrali-Americana (February, 1890), finally includes both *clarkii* and *magister* as unconditional synonyms of *S. spinosus*, evidently because he found a "want of agreement between the number of pores and the distribution of the species." However, had he first separated *clarkii* and *magister* by their proper characters which are not to be found in the number of femoral pores, he could not have missed the agreement looked for.

I must myself plead guilty of having confounded *S. clarkii* and *S. magister*, misled, as I was, by the almost unanimous verdict of herpetologists. If there was a settled question in regard to the *Scelopori*, I thought surely to have it in the identity of these two names. I regarded no identification more secure than that of the specimens collected by Dr. Merriam in the Grand Cañon of the Colorado as *S. clarkii*.* As a matter of fact, however, they are *S. magister*.

That I was finally undeceived is principally due to Mr. P. L. Jouy, who, while collecting for the National Museum near Tucson, southern Arizona, in 1891, had the good fortune to observe both species alive. In sending the specimens, he wrote me that he had undoubtedly two species which he could distinguish not only by their color when alive, but also by their habits and the different localities which they frequented, one being shy and agile, the other fearless and sluggish; one found only on the mesa and on the ground, the other near the river, and chiefly on trees and bushes. Not being able, upon a cursory examination, to find any tangible character, I wrote back that there was only one big *Sceloporus* and *S. clarkii* was its name. Upon his return, Mr. Jouy again brought up the question, and as he was so very persistent, I promised him to examine all the material carefully, a promise made more to please him than because I expected a different result. I went to work and it just so happened that the first two specimens which I picked up belonged each to a different species. My eye at the very first glance hit upon the most distinctive character which separates the two, viz, the difference in the spiny scales which protect the anterior border of the ear opening, a difference which is quite apparent upon an examination of the accompanying figures (Pl. I, figs. 1 and 2). The constancy of the character was soon verified in a large series of specimens, as well as the concomitancy of the presence or absence of dusky cross markings on the dorsal aspect of the forearm and hand.

It would have been difficult to ascertain the correct names of the two species from the published descriptions, but the types of both *S. clarkii* and *S. magister* are still in the collection, and fortunately they belong respectively to the two species.

Upon plotting on a map the various localities from which I have examined specimens (about forty), it was shown that the two species inhabit different areas, and that the habitats come together and partly overlap in southeastern Arizona, notably around Tucson. But here

* North American Fauna, No. 3, p. 110.

it is useful to remember Mr. Jouy's observation that the two species live apart in separate localities.

Sceloporus magister, according to this, inhabits the desert region of southern California, as verified by numerous examples brought home by the Death Valley Expedition and enumerated hereafter. Material from the same source shows that it penetrates into southern Nevada, and easterly into southwestern Utah, while Dr. Merriam, during his San Francisco Mountain Expedition in 1889, demonstrated its occurrence in the Grand Cañon of the Colorado. The most northern locality from which the species has been brought, and which has never before been recorded, I believe, is the Big Bend of the Truckee River in Nevada, at 'Camp 12' of King's expedition, where numerous specimens were collected by Mr. Robert Ridgway. Eastward it has been found in the deserts of southern Arizona as far as Fort Verde and Tucson.

Sceloporus clarkii, on the other hand, within the United States, seems confined to southeastern Arizona, whence it is found southward into Mexico for an unknown distance, probably confined to the western slope of the Sierra Madre, for it is pretty certain that *S. clarkii* and all its allied forms, or species, are confined to the western slope of the continent.

The map used for plotting the distribution of the two species was the summer 'Rain-chart of the United States' by Charles A. Schott (published by the Smithsonian Institution in 1868) and the coincidence of the dividing line between the two species with the isohyetal line of 6 inches seems to be more than accidental.

Farther south in Mexico we find the typical *S. clarkii* replaced by a nearly related form, which, as it has received no name before, we may call *S. boulengeri*;* Boulenger's *S. spinosus* being in part this form.

Still farther south we have another modification of the same type in *Sceloporus acanthinus* Boc., with its excessively long points to the dorsal scales. The locality whence came the type is St. Augustine, on the west slope of the volcano of Atitlan, Guatemala.

Sceloporus magister has also representative forms toward the south. A very distinct species, but apparently of rather restricted distribu-

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* **Sceloporus boulengeri**, sp. nov., Plate I, figs. 5*a*.–*c*.

Diagnosis.—Similar to *S. clarkii* but with fewer femoral pores; ear spines comparatively short and broad; interparietal very broad.

Habitat.—Mexico, west coast from Mazatlan to Guaymas.

Type.—U. S. Nat. Mus., No. 14079; Presidio, about 50 miles from Mazatlan, Sinaloa, Mexico; A. Forrer, coll.

In the width of the interparietal the present form agrees with *S. zosteromus*, but the latter has nearly twice as many femoral pores, and its ear spines are long, narrow, and numerous.

tion, of which specimens have come to hand only quite recently, is *Sceloporus orcutti*.* The only specimens seen have come from San Diego County, Southern California, and the only exact locality known is the Milquatay Valley, which Mr. C. R. Orcutt, who collected the specimens, and in whose honor the species is named, informs me "is just bordering the Mexican boundary, 50 miles east of San Diego by wagon road." It probably penetrates some distance south into the northern part of Lower California, in the southern portion of which its place is taken by *S. zosteromus*.† This species is closely allied to *S. magister*. *S. clarkii*, on the other hand, is more different from the latter than the latter is from *S. zosteromus*.

I have above alluded to Mr. Boulenger having made *S. floridanus* a synonym of his *S. spinosus* var. *clarkii*. Cope, on the other hand, makes it a synonym of *S. undulatus* (Proc. Am. Philos. Soc., XXII, 1885, p. 398), but both are wrong, as an examination of the type specimen clearly proves. The fig. 6 on Plate I from this specimen shows that it has nothing to do with *S. clarkii*, or any species of the group to which the latter belongs. On the other hand, the size of the dorsal scales easily distinguishes it from *S. undulatus*. It is in fact the same form which occurs all through southern Texas and which has commonly been called *S. spinosus*. It is fairly separable from the true Mexican *S. spinosus* by the greater number of femoral pores. The form occurring within the United States will therefore stand as *Sceloporus floridanus*, or *S. spinosus floridanus* (notwithstanding the fact that it does not occur in the peninsula of Florida) if the number of femoral pores should be found to intergrade. The most eastern point where this form has been found is Pensacola, Fla.; hence the name. It is needless to add that *S. thayeri* B. & G. does not belong here; on the other hand, the specimens so described and figured by Bocourt certainly do.

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*Sceloporus orcutti sp. nov., plate I, figs. 4*a–c*.

Diagnosis.—Similar to *Sceloporus magister*, but dorsal scales smaller, seven in a head length, very obtusely keeled and the spiny point scarcely protruding beyond the rounded outline; no nuchal collar; back with cross-bands of dark and paler brown, the dark bands being broader than the pale ones; whole underside pale grayish blue, without definite patches, the large males with the blue somewhat darker on throat, flanks, and thighs.

Locality.—Milquatay Valley, San Diego County, Calif.

Type.—U. S. Nat. Mus., No. 16330; Charles R. Orcutt, coll.; January 5, 1890.

Although manifestly related to *S. magister*, this is perhaps the most distinct-looking species of the whole group, the comparative smoothness of the back and the very peculiar coloration being quite notable. The under surface is particularly remarkable when compared with the allied species, it being in fact unique among all the *Scelopori* which I have examined. It is quite probable, however, that the blue in the old males may deepen and darken as the season advances.

The constancy of the species can be vouched for, as I have examined ten specimens, eight of which are now before me, and they are all alike.

†Plate I, fig. 3, shows some of the more essential characters of this species for comparison with the allied forms.

It will thus be seen that—even looking apart from *S. horridus*—we find ourselves compelled to recognize at least six distinct forms, or species, where so high an authority as Prof. Günther as late as 1890 has admitted only one. This different result is chiefly due, however, to the much more abundant material at my command, for while the herpetologists of the British Museum had scarcely more than 30 specimens to draw conclusions from, I am fortunate enough to have before me nearly 200 specimens, mostly from well authenticated localities, upon which to base the above results.

[The large scaly lizard known as *Sceloporus magister* is a Lower Sonoran species ranging across the southern deserts and desert ranges of the Great Basin from California to Arizona and southwestern Utah. Unlike most of the lizards inhabiting the same region, it does not run about on the open desert, but lives on the tree yuccas, the ruins of stone or adobe dwellings, the nests of wood rats, and other objects that afford it shelter and protection. At the mouth of Beaverdam Creek in northwestern Arizona it was common among cottonwood logs and dead leaves; in Pahranagat Valley it was abundant about the ruins of stone houses and along the faces of cliffs; in the Mohave Desert and other localities it is common on the tree yuccas, where it was often found on the very summits of the highest branches, and where it was rather wary and difficult of capture without a gun.

In California it occurs throughout the Mohave Desert, ranging as far west as the tree yuccas in Antelope Valley and Walker Pass, and thence easterly in Owens Valley, Borax Flat, and the Argus and Panamint mountains.

In Nevada it was found on the Grapevine Mountains, in Ash Meadows, in Pahrump Valley at the foot of the Charleston Mountains, in Vegas and Indian Springs valleys, in Pahranagat Mountains and Valley, at the Great Bend of the Colorado River, and in the valley of the Virgin.

In Arizona it was abundant at the point where Beaverdam Creek joins the Virgin.

In Utah it was common in the Lower Santa Clara or St. George Valley.

Sceloporus magister is a mixed feeder, both insects and flowers being found in the stomachs examined. At the Great Bend of the Colorado, Nevada, and St. George, Utah, stomachs were opened that contained insects only. One from the latter locality contained a large goldsmith beetle.—C. H. M.]

List of specimens of Sceloporus magister.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18096	♀	Pahranagat Valley, Nev		May 23	Merriam	
18097	♂	do		do	do	
18098	♀	do	4,100	do	do	
18099	♀	do		do	Bailey	
18100	♀ juv.	do		do	Merrian	
18101	♂ juv.	do		May 25	Bailey	
18102	♀	Pahranagat Mountains, Nev		May 26	Merriam	
18103	♂	Pahrump Valley, Nev	5,000	Apr. 29	do	Yacca belt.
18104	♂	Callville, Nev		May 4	Bailey	
18105	♂	Ash Meadows, Nev		Mar. 16	Nelson	
18106	♂ juv.	do		Mar. 20	Palmer	
18107	♂	Vegas Valley, Nev		May 1	Bailey	
18108	♂	Indian Spring Valley, Nev		May 29	Merriam	
18109	♂	do		do	Bailey	
18110	♂ juv.	Grapevine Mountains, Nev		June 8	Nelson	4,000 feet above Salt Wells, Mesquite Valley.
18111	♂ juv.	Bunkerville, Nev		May 8	Merriam	
18112	♂	St. George, Utah		May 12	Bailey	
18113	♂	do		May 13	do	
18114	♂	Diamond Valley, 10 miles north of St. George, Utah.	4,800	May 16	Merriam	Lava rock.
18115	♂	do	4,800	May 16	do	Do.
18116	♂	Panamint Mountains, Cottonwood Cañon, Calif.		June 14	Nelson	4,400 feet above Salt Wells.
18117	♂	do	3,900	May 29	do	
18118	♂	Panamint Mountains, Willow Creek, Calif.	3,800	May 22	do	
18119	♀ juv.	do	4,600	May 17	do	
18120	♀	Walker Pass, Calif	4,000	July 2	Bailey	
18121	♀	do	4,000	July 1	do	
18122	♀	do	4,000	do	do	
18123	♂	Mohave, Mohave Desert, Calif		June 26	Palmer	
18124	♂	Near Mohave, Mohave Desert, Calif.		do	Merriam	
18125	♂	do		do	do	
18126	♂	do		Apr. 6	do	
18127	♂	Mohave Desert, near base of Granite Mountains, Calif.		Apr. 25	Bailey	On rocks.
18128	♀	Argus Range, Shepherd Cañon, Calif.		Apr. 29	Fisher	
18129	♀	do		Apr. 27	do	
18130	♀	Argus Range, Searl's Garden, Calif.	3,000	Apr. 24	Stephens	
18131	♂	Owens Valley (Lone Pine), Calif		June 11	Fisher	
18132	♀ juv.	do		June 12	do	
18133	♂	Columbus, Nev		Dec. '90	Bailey	

Sceloporus graciosus B. & G.

The size of the dorsal scales in this species is very variable, the number of scales in a head length varying from eleven to sixteen. Both extremes are represented in the present collection. In the two smallest specimens the numbers are fifteen and sixteen; in a slightly larger one from Mount Magruder, Nevada, there are fourteen; in two full-grown specimens from the same locality, thirteen and twelve; one from the east slope of the High Sierra west of Lone Pine, Calif. (altitude 8,000 feet), has also twelve; and in a couple from the Juniper Mountains, Nevada altitude 6,700 feet), the number of scales in a head length is only eleven. From this it might be supposed that the difference in the ratio between the head and the dorsal scales depended upon age, but in the types of the species (U. S. Nat. Mus. 2877, Great Salt Lake, Utah, Capt. Stansbury coll.), which are fully as small as the smallest specimens mentioned above with fifteen and sixteen scales to the head length, the number is only twelve, while in two full-grown males from Fort Klamath, Oregon (U. S. Nat. Mus. Nos. 15437–15438, Dr. Merrill, coll.), there are fifteen and fourteen, respectively.

[This species, which is a characteristic inhabitant of the Upper Sonoran and Transition zones in northern Nevada, eastern Oregon, and Idaho, was very abundant on the sage-covered plateau of Mount Magruder at an altitude of about 2,450 meters (8,000 feet); in the sage plains on top of the White and Inyo mountains near the boundary between California and Nevada; and on the east slope of the Sierra Nevada west of Owens Valley (at 2,450 meters, or 8,000 feet). It was common also among the sage and juniper on the Juniper Mountains along the boundary between Nevada and Utah.

Sceloporus graciosus is generally found in company with such Transition Zone species as the sage thrasher (*Oroscoptes montanus*), Brewer's sparrow (*Spizella breweri*), the Nevada sage sparrow (*Amphispiza belli nevadensis*), the sage plains chipmunk (*Tamias minimus pictus*), the sage brush pocket mouse (*Perognathus olivaceus*), and the sage plains spermophile (*Spermophilus mollis*).—C. H. M.]

List of specimens of Sceloporus graciosus.

U. S. Nat. Mus. No.	Sex and Age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18134	♀	Mount Magruder, Nev	8,000	June 6	Merriam	Sage Plain.
18135	♀	......do	8,000	..do	....do	Do.
18136	♀	......do	8,000	..do	Bailey	Do.
18137	♂	Juniper Mountains, Nev	6,700	May 19	Merriam	In junipers.
18138	♀	Juniper Mountains (Sheep Spring, 15 miles east of Panaca), Nev.	6,700	..do	Bailey	
18139	♂	High Sierra, west of Lone Pine, Calif.	8,000	June 18	Merriam	
18140	♀	Panamint Mountains, Willow Creek, Calif.	6,400	May 12	Nelson	
18141	♂	(?)		(?)	(?)	(*)

*Without label, but with the following note by Mr. Charles W. Richmond: "Rec'd July 2, 1891, with specimens from Grapevine Mountains, Lone Pine, etc."

Sceloporus bi-seriatus Hallow.

The great majority of *Scelopori* brought home by the expedition belong to this form, which in the region visited seems to occur everywhere above the desert belt at least up to 8,000 feet altitude.

I can discover no difference between the examples from the mountains inclosing the Valley of California and those from the isolated desert ranges to the east, except that male specimens with the white of the under surface replaced by black are more common from the latter localities.

Among the localities from which specimens were brought are the type localities of Hallowell's *bi-seriatus*, with its several color varieties, of Baird's *longipes*, of Cope's *smaragdinus*, and of Boulenger's *bocourtii*;

and with the actual types of Baird and of Cope, and with specimens before me out of the same bottles upon which Boulenger founded his variety, I have no hesitation in pronouncing all these names synonymous, and in asserting that Bocourt's *S. biseriatus* is the same as Hallowell's. Boulenger's *bocourtii*, however, is somewhat composite, as I do not believe that the Monterey specimens, at least, belong to it. I have no doubt that they are referable to *S. occidentalis*, with which the present form is easily confounded, on account of the fact that both differ from typical *S. undulatus* in the females having the blue patches almost as well developed as the males.*

[*Sceloporus biseriatus* is one of the few lizards inhabiting both the desert ranges of the Great Basin and the interior valley of California. Specimens were obtained at frequent intervals all the way from the Upper San Joaquin Valley, in California, to the Upper Santa Clara Valley, in Utah, about 10 miles northwest of St. George. On the east side of the Great Divide, in California, it was obtained on the Panamint, Argus, Coso, White, and Inyo mountains, and at the east foot of the Sierra in Owens Valley (on Independence Creek). On the west side of the Great Divide it was common on the west slope of Walker Pass and thence down into Kern Valley to the neighborhood of Kernville, and southerly along the west slope of the Sierra to Havilah and Walker Basin, and northerly to Three Rivers. It was common also in the Cañada de las Uvas, and in the Upper San Joaquin Valley, where specimens were collected at Kern Lakes, Tulare, and Fresno. In Nevada it was collected on the Charleston Mountains (near Mountain Spring), on Mount Magruder, in the Juniper Mountains, and in the Grapevine Mountains.

A black form (having the belly intensely blue-black) was found on black lava rock in Diamond Valley, Utah; on the Charleston Mountains (near Mountain Spring), Nevada, where it was found both on rocks and on juniper trees, and on the White Mountains, near the eastern boundary of California. In the latter locality it was common on the summit of the divide near the road between Deep Spring and Owens valleys, where it was frequently seen on and among light colored rocks, which made it unusually conspicuous. It is entirely possible, however, that this very striking contrast is a protection, causing the lizard to resemble the dark cracks in the rocks when viewed from above by passing hawks.—C. H. M.]

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*Yarrow's *S. undulatus thayeri* (Bull. U. S. Nat. Mus., 24, p. 60) consists mainly of *S. bi-seriatus*, but also to some extent of *S. occidentalis*. To the latter are also referable Cope's specimens similarly named in Proc. Phil. Ac., 1883, p. 28, and probably *loc. cit.*, pp. 23 and 27.

List of specimens of Sceloporus biseriatus.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18147	♂	Panamint Mountains, Calif	8,000	Apr. 19	Nelson	
18148	♂	do	6,000	Apr. 4	do	
18149	♂	do	6,000	do	do	
18150	♂	do	6,000	Apr. 3	do	
18151	♂	do	6,000	do	do	
18152	♀ juv.	do	6,000	do	do	
18153	♀ juv.	do		Mar. —	do	
18154	♂	do	*6,000	Mar. —	do	
18155	♂	Panamint Mountains, Willow Creek, Calif.	4,500	May 19	do	
18156	♂	Panamint Mountains, Johnson Cañon, Calif.		Mar. 31	Fisher	
18157	♂	do		do	do	
18158	♂	do		Apr. 11	do	
18159	♂	do		Apr. 2	do	
18160	♂	do		Apr. 4	do	
18161	♂	do		Apr. 10	do	
18162	♀	do		Apr. 4	do	
18163	♂	Coso Mountains, Coso, Calif		May 18	do	
18164	♂	do		May 23	do	
18165	♂	do		May 21	do	
18166	♂	do		May 20	do	
18167	♀	do		do	do	
18168	♀ ad.	do		do	do	
18169	♂	Old Fort Tejon, Calif		June 28	Palmer	
18170	♂	do		do	Merriam	
18171	♂	do		June 29	Palmer	
18172	♀	do		July 3	do	
18173	♂	do		July 5	do	
18174	♀	do		July 8	do	
18175	♂	South Fork Kern River, 25 miles above Kernville, Calif.		July 7	Fisher	
18176	♂	Kernville, Calif		June 23	Palmer	
18177	♂	do		do	do	
18178	♂	South Fork Kern River, Calif	2,750	July 7	Bailey	
18179	♂	Walker Basin, Calif		July 14	Fisher	
18180	♀	do		do	do	
18181	♂	Havilah, Calif		June 24	Palmer	
18182	♀ ad.	do		do	do	
18183	♀	do		do	Merriam	
18184	♀	Fresno County, Horse Corral Meadow, Calif.		Aug. 11	Palmer	
18185	♀ ad.	do		do	do	
18186	♀	do		do	Fisher	
18187	♂	Walker Pass (West Slope), Calif		July 7	do	
18188	♂	Cañada de las Uvas, Calif		Oct. 14	Nelson	
18189	juv.	do		do	do	
18190	♂	White Mountains, Calif	8,000	June 9	Merriam	
18191	♀	Soda Springs, Kern River, Calif		Aug. 15	Bailey	
18192	♂	Three Rivers, Calif		July 28	Fisher	
18193	♀	Tulare, Calif		July 21	Bailey	
18194	♂	Kaweah River, East Fork, Calif	5,600	July 29	do	
18195	♂	San Joaquin River, Calif	7,600	do	Nelson	
18196	♂	Argus Range, Shepherd Cañon, Calif		May 7	Fisher	
18197	♀	East Slope High Sierra, Independence Creek, Calif.	6,000	June 21	Stephens	
18198	♂	Charleston Mountains, Mountain Spring, Nev.	5,600	Apr. 30	Bailey	
18199	♂	do	5,600	do	do	
18200	♂	do	5,600	do	Merriam	
18201	♀	do	5,600	do	do	
18202	♂	Mount Magruder, Nev		June 5	do	
18203	♀	do		do	do	
18204	♂	Juniper Mountains, 12 miles east of Panaca, Nev.	6,700	May 19	Bailey	
18105	♀	Grapevine Mountains, Nev	6,400	June 10	Nelson	
18206	♂	Ten miles west of St. George, Utah	4,800	May 16	Bailey	On lava roc[k]

* About.

Sceloporus occidentalis B. & G.

The Monterey specimens enumerated below belong to the present for[m] of *S. undulatus*. The status of these two forms relative to each othe[r] has not been settled yet, nor has the material necessary for such settlement been accumulated so far in any museum. Under these circumstances nothing is gained by using a trinominal.

List of specimens of Sceloporus occidentalis.

U. S. Nat. Mus. No.	Sex and Age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18143	♂	Monterey, Calif.		Oct. 6	Bailey	
18144	♂	do		Oct. 3	do	
18145	♂ juv.	do		Sept. 29	do	
18146	♂ juv.	do		Sept. 30	do	

Phrynosoma blainvillii Gray.

That authors with only specimens of either *Ph. blainvillii* or *Ph. coronatum* before them should consider both species synonymous is perhaps not to be wondered at, but a confusion of them, with both at hand, is not so easily explained. The differences are marked, numerous, and constant, and moreover, are easily expressed. The two species inhabit two well separated zoölogical faunas, for while *Ph. coronatum* appears to be restricted to the Cape region of Lower California—that is to say, to the comparatively small mountainous area at the extreme southern end of the peninsula, on which are located Cape St. Lucas, La Paz, and San José del Cabo—*Ph. blainvillii* is restricted, so far as we know, to Upper California. How far down the peninsula the latter species descends we do not know, and whether there is any other gap between the two species than the low, sandy plains to the north of the Cape region remains to be seen; but it is somewhat significant that Cerros Island, about halfway down the peninsula, is inhabited by a third species,* more nearly related to *Ph. blainvillii* than to *Ph. coronatum*.

The title of the Californian species to the name *Phrynosoma blainvillii* Gray is at present not entirely beyond a suspicion. The facts in the case are as follows:

In the 'Zoölogy of Capt. Beechey's Voyage' (published in 1839), J. E. Gray (p. 96), shortly and insufficiently characterized a new species of *Phrynosoma* from 'California' as *Ph. blainvillii* without stating the source of the specimen or whether more than one specimen served as a basis for his description. The text is accompanied by a wretched figure (Pl. XXIX, fig. 1). The description gives no clew to the identity of the species, but were I to go by the figure alone, I should unhesi-

*Phrynosoma cerroense, sp. nov.

Diagnosis.—Nostrils excessively large, pierced in the line of canthus rostralis; gular scales enlarged, in several longitudinal rows; ventral scales smooth; a long and slender spine between the sublabial rictal spine and the lower end of the ear; medium occipital spine reduced to a tubercle; no row of spines between eye and temporal spines; lower peripheral spine row obsolete and only indicated by a few scattered small spines.

Habitat.—Cerros Island, Pacific coast of Lower California.

Type.—U. S. National Museum, No. 11,977; L. Belding coll.

tatingly refer it to the Upper Californian species, bad as the figure is, and not to *Ph. coronatum* from Cape St. Lucas. However, in his 'Catalogue of the Specimens of Lizards in the British Museum' (1845), Gray himself identifies his species with *Ph. coronatum* and states in so many words that his *Ph. blainvillii* was based upon a specimen presented by Prof. De Blainville (see also his statement in the introduction, p. v., that "the specimens presented by M. De Blainville may be regarded as the types of the species described by that professor in the *Nouveaux Memoires du Museum*)." In addition he enumerates three more specimens from 'California.' This would seem to settle the case in favor of making *Ph. coronatum* and *Ph. blainvillii* synonymous, but there are yet two possibilities. First, it must be remembered that Botta, whose collection was the basis of De Blainville's description, evidently collected both at the Cape St. Lucas (where he obtained *Callisaurus draconoides*, *Cyclura acanthura*, *Coluber vertebralis*), and also further north in Upper California, probably near San Diego (where he secured *Coluber catenifer*; *C. infernalis*; *C. californiae*). It is, therefore, quite possible that he collected horned-toads at both places, and that the young specimen presented to the British Museum in reality was different from *Ph. coronatum*. Whether this be the case could easily be settled in the British Museum, where the specimen is still preserved. In the second place, it is possible that Gray had figured one of the other specimens then in the British Museum, and that the specimen figured belongs to the Upper Californian species. If that be the case the name *Ph. blainvillii* would stick to the latter no matter which specimens Gray *subsequently* might designate as the type.

There is some additional inferential evidence which tends to corroborate this opinion, viz, that Boulenger with the above specimens before him and additional specimens from Monterey refers them all to one species (Cat. Liz. Brit. Mus., II, 1885, pp. 243, 244), as it seems but little probable that he should have failed to appreciate the great difference, had both species been represented in his series.

The geographical distribution of *Ph. blainvillii* includes the interior valley of California as well as the entire western slope of the various coast ranges, but it is not found, so far as I know, anywhere in the true desert region. It is true that Yarrow's Catalogue (Bull. U. S. Nat. Mus., No. 24, 1883, p. 70) enumerates two specimens as having been collected by Dr. Loew in the Mohave Desert, but I have good reasons for asserting that the locality is in all probability erroneous. In the original entry of No. 8647 only one specimen is registered, while the bottle now contains three specimens so numbered, a fact which throws discredit upon the whole entry; and as Dr. Loew collected near Santa Barbara and at Santa Cruz Island in June, 1875, as shown by the records, the probability is that the specimens in question came from one or both of those localities.

It is to *Ph. blainvillii* that the published accounts about ejecting blood from the eyes should be credited, and one of the specimens in the collection brought home (No. 18452) is the offender who gave rise to Dr. O. P. Hay's entertaining article (Proc. U. S. Nat. Mus., xv, 1892, pp. 375–378) on this subject. It transpired afterwards that this specimen had been sent me alive for the very reason that it had been ejecting blood repeatedly when caught. The letter from Mr. Bailey accompanying the specimen turned up long after Dr. Hay's experience with the animal, and it is to the following effect:

KERNVILLE, CAL., *July 11, 1891.*

DEAR SIR: I caught a horned toad to-day that very much surprised Dr. Fisher and myself by squirting blood from its eyes. It was on smooth ground and not in brush or weeds. I caught it with my hand and just got my fingers on its tail as it ran. On taking it in my hand a little jet of blood spurted from one eye a distance of 15 inches and spattered on my shoulder. Turning it over to examine the eye another stream spurted from the other eye. This he did four or five times from both eyes until my hands, clothes, and gun were sprinkled over with fine drops of bright red blood. I put it in a bag and carried it to camp, where, about four hours later, I showed it to Dr. Fisher, when it spurted three more streams from its eyes. One of the same species that I caught July 2 evidently did the same, as I found its head covered with blood when I caught it, but supposed it was injured in the weeds. It seems so strange that I send the horned toad to you alive.

VERNON BAILEY.

The specimen upon its arrival was handled a great deal, but gave no evidence of its blood-squirting tendencies until the beginning of August, when it resented Dr. Hay's handling it somewhat roughly in the manner related. In order to give the entire history of this animal, I reprint Dr. Hay's account as follows:

"About the 1st of August it was shedding its outer skin, and the process appeared to be a difficult one, since the skin was dried and adhered closely. One day it occurred to me that it might facilitate matters if I should give the animal a wetting; so, taking it up, I carried it to a wash-basin of water near by and suddenly tossed the lizard into the water. The first surprise was probably experienced by the *Phrynosoma*, but the next surprise was my own, for on one side of the basin there suddenly appeared a number of spots of red fluid, which resembled blood. . . . . . A microscope was soon procured and an examination was made, which immediately showed that the matter ejected was really blood.

"The affair now became very interesting. Just where the blood came from I could not determine with certainty, the whole thing having happened so suddenly and unexpectedly; yet the appearance seemed to indicate that the blood came from the region about one of the eyes. There appeared to be a considerable quantity of the blood, since on the sides of the vessel and on the wall near it I counted ninety of the little splotches. A consultation was had with Mr. Stejneger the next day with regard to the propriety of dashing the animal into the water again to discover, if possible, where the blood came from.

It was thought, however, that such blood-lettings must be somewhat exhausting, and that it would be better to allow the animal a day to recuperate. While talking I picked up the lizard and was holding it between my thumb and middle finger, and stroking its horns with my fore-finger. All at once a quantity of blood was thrown out against my fingers, and a portion of it ran down on the animal's neck; and this blood came directly out of the right eye. It was shot backward and appeared to issue from the outer canthus. It was impossible to determine just how much there was of the blood, but it seemed that there must have been a quarter of a teaspoonful. I went so far as to taste a small quantity of it, but all that I could detect was a slight musky flavor."

[The fact that horned toads at times eject blood from their eyes is well known in the West, and is by no means confined to the present species. I have been aware of the habit for many years.

Phrynosoma blainvillii is the horned toad of the interior valley and coastal slopes of California. Specimens were obtained by our expedition on the west slope of the Sierra Nevada in Walker Pass, in Kern Valley, Walker Basin, and at old Fort Tejon in the Cañada de las Uvas; and others were collected at Bakersfield and Fresno in the San Joaquin Valley, and on Carrizo Plain.—C. H. M.]

List of specimens of Phrynosoma blainvillii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18446	♂	Walker Pass, Calif		July 2	Bailey	
18447	♀	do		do	do	
18448	♂	do		do	Fisher	Western slope.
18449	♂	Walker Basin, Calif		July 14	Bailey	
18450	♀	South Fork, Kern River, Calif	2,750	July 7	do	
18451	♀	Kernville, Calif		June 23	Palmer	
18452	♂	do		July 11	Bailey	Ejected blood from eye.
18453	♂ jun.	Fresno, Calif		Sept. 23	do	
18454	♂ juv.	do		do	do	
18455	♀ jun.	do		do	do	
18456	♀	Bakersfield, Calif		Oct. 11	Nelson	
18457	♂	Carrizo Plains, Calif		do	do	
18458	♀	do		do	do	
18459	♀	Old Fort Tejon, Calif		July 4	Palmer	Pl. II, fig. 2.
18460	♂ jun.	Cañada de las Uvas, Calif		July 9	do	

Phrynosoma platyrhinos Girard.

Boulenger asserts that this species is "very closely allied" to *Ph. m'callii*, (Cat. Liz. Br. Mus., II, 1885, p. 247), but as a matter of fact these species are as distinct as any two in the genus. Boulenger's error, undoubtedly, arose from the fact that the specimen he described as *Ph. m'callii* is not this species at all, but only another specimen of *Ph. platyrhinos*. No wonder his specimens are "very closely allied!" Had he compared his specimens with the descriptions and figures *quoted by him* he would not have made the mistake; as it is, he has taken the identification of his specimen (U. S. Nat. Mus. No. 10785) by Dr. Yarrow as conclusive, without knowing that not a single specimen of all the horned-toads enumerated by Yarrow in his Catalogue of Reptiles in the U. S. National Museum really belongs to *Ph. m'callii.*

The fact, however, that Boulenger had given characters apparently separating northern and southern specimens, led me to examine the material at hand with a view to ascertain whether it might be possible to recognize two or more races, but an inspection of about one hundred and seventy-five specimens fails to disclose any character or combination of characters by which to separate them. The shape of the head, length, shape, and direction of head spines, length of limbs, number of femoral pores, and coloration are so variable that no separation can be built upon any of these characters. To illustrate this, let me discuss the contents of the two jars out of each of which Mr. Boulenger had one specimen, viz: U. S. Nat. Mus., No. 10785 and 11770. The former is Boulenger's so-called *Ph. m'callii*, with the occipital spines as long as the horizontal diameter of the orbit, and seven femoral pores on each side.

In No. 10785 (locality and collector now unknown), out of which came Boulenger's so-called *Ph. m'callii*, there are now left seven specimens, six males and one female. The number of femoral pores on each side in the males are respectively 9, 8, 7, 7, 9, 8, and in the female 7; in the latter the occipital horns are comparatively best developed, and in at least one of the large specimens this horn is considerably shorter than the horizontal diameter of the orbit.

In No. 11770 (Camp 12, King's Exped., Nevada, R. Ridgway, coll.) there are now six specimens, three adult males and one young, and one adult and one young female. The number of femoral pores in the adult males are respectively 9, 10, 8, and in the adult female 9; in the first-mentioned male the occipital spine is longer than the horizontal diameter of the orbit; in the second, the two dimensions are equal; in the third male and in the female the spines are shorter. As there seems to be a slight average difference between the specimens in the two jars, I was led to examine my series with a view to determine whether the southern specimens average a smaller number of femoral pores than northern ones, but without success.

The reëxamination of my material, however, led to the unexpected discovery of a new species from the sandy coast desert of the Mexican state of Sonora, which I have called *Ph. goodei*,* and dedicated to Dr.

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*Phrynosoma goodei sp. nov. (plate ii, figs. 3, *a–e*).

Diagnosis.—Nostrils pierced within the canthi rostrales; one series of enlarged spines around the periphery of the body; tail more than twice the length of the head; tympanum entirely concealed by scales; 7–10 femoral pores; 3 temporal horns only on each side, the posterior one nearly on a line with and of the same size as the occipital horns; only three posterior inframaxillary plates spinous.

Habitat.—Coast deserts of the state of Sonora, Mexico.

Type.—U. S. Nat. Mus. No. 8567*a*; *Dr. T. H. Streets* coll.

G. Brown Goode, the Assistant Secretary of the Smithsonian Institution. It belongs to the same group which embraces *Ph. cornutum*, *m'callii*, and *platyrhinos*, but is hardly more closely allied to one than to the others. It may easily be distinguished by the diagnosis given in the footnote, and for comparison with *Ph. platyrhinos* I add figures of both on plate II.

Ph. platyrhinos appears to be distinctively a desert species, as it was collected nearly everywhere, outside of the interior valley of California and the Pacific slope, where members of the expedition went, and judging from the great number of specimens brought back it must be very common. The range of the species covers that of *Callisaurus ventralis* within the territory of the United States, but extends considerably further east and north.

As with the other species of this genus the ground color of the living animal is subject to great variation, more or less dependent upon the coloration of the surroundings. The specimens collected by the expedition vary from a very pale, in some nearly whitish, drab gray to a vivid brick-red.

[Horned toads abound throughout the desert regions of the West. *Phrynosoma platyrhinos* inhabits the Lower Sonoran deserts of the Great Basin from California to Utah and ranges up a short distance into the Upper Sonoran. In California it was found in greater or less abundance in the Mohave Desert, in Owens, Coso, Panamint, Death, Mesquite, and Deep Spring valleys, and in the Argus, Funeral, and Panamint mountains (up to 1,740 meters or 5,700 feet on west slope northwest of Wild Rose Spring). In Nevada it was abundant in Sarcobatus Flat, the Amargosa Desert, Ash Meadows, Indian Spring, Pahrump, Vegas, Pahranagat, and Meadow Creek valleys, and the Valley of the Virgin and Muddy. In the northwestern corner of Arizona it was very abundant about the mouth of Beaverdam Creek and thence up on the west slope of the Beaverdam Mountains. In Utah it was common in the Santa Clara Valley ranging up through the sage brush to Diamond Valley and Mountain Meadows.

At Ash Meadows in the Amargosa Desert a very white form was found living on the white alkali soil.

The horned toads of the San Joaquin Valley and west slope of the Sierra Nevada in California belong to another species, *Phrynosoma blainvillii*—C. H. M.]

List of specimens of Phrynosoma platyrhinos.

Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
		Feet.			
♂	Virgin Valley, Ariz		May 10	Merriam	
♂	do		do	do	
♂	do		do	do	
♂	do		do	do	
♂	do		do	do	
♂	do		do	do	
♂	do		do	do	
♂	do		do	do	
♀	do		do	do	
♀	do		do	do	
♂	do		May 9	do	
♂	St. George, Utah		May 13	do	
♀	do		do	do	
♀ jun.	do		do	do	
♀	Mountain Meadows, Utah		May 17	do	
♂	Panaca, Nev		May 19	do	
♂ juv.	do		do	do	
♀	do		do	do	
♂	Grapevine Mountains, Nev		June 6	Nelson	4,200 feet above Salt Wells.
♂	Lincoln County, Nev		Mar. 12	do	Colorado River.
♀	do		do	do	
♂	Indian Spring Valley, Nev		May 29	Bailey	
♀ jun.	do		do	do	
♂	Pahrump Valley, Nev		April 29	do	
♂	do		do	do	
♂	Pahranagat Valley, Nev		May 25	do	
♀	do		do	do	
♂	do		do	Merriam	
♂	Vegas Valley, Nev		Mar. 9	Bailey	
♂	do		do	Nelson	
♂	Amargosa Desert, Nev		May 31	Merriam	
♀	do		do	do	
♀	do		do	do	
♀ juv.	Ash Meadows, Nev		Mar. 4	Bailey	
♂	do		Mar. 3	Stephens	
♂	do		Mar. 4	Palmer	
♂	do		Mar. 20	do	
♂	do		do	do	
♂	do		Mar. 4	Nelson	
♂	do		May 30	Merriam	
♂ juv.	do		Mar. 21	Fisher	
♂	do		do	do	
♂ jun.	do		do	do	
♂	do		May 30	Merriam	
♂	Amargosa, Nev		Mar. 8	Palmer	
♀	Funeral Mountains, Calif		Mar. 16	do	1,000 feet above Borax works.
♀	Argus Range, head of Borax Flat, Calif.	3,000	Apr. 21	Stephens	
♀	Water Station, head of Borax Flat, Calif.		Apr. 22	do	
♂	Death Valley, Calif	5,000	Apr. 3	Bailey	Panamint Mts.
♀ jun.	Death Valley, Bennett Wells, Calif.		Jan. 21	Palmer	
♀	Death Valley, Furnace Creek, Calif.		Jan. 30	Fisher	
♂	do		Apr. 10	Stephens	
♀ jun.	10 miles from Resting Springs, Calif		Mar. 17	Palmer	
♂	Saline Valley, Calif	1,500	June 30	Nelson	
♂	Panamint Mountains, Wild Rose Spring, Calif.	5,300	Apr. 16	Bailey	
♂	do	do	do	do	
♀	do	do	do	do	
♀	do	do	do	do	
♀	Panamint Mountains, Willow Creek, Calif.	5,000	May 16	Nelson	
♂	Panamint Valley, Wild Rose Spring, Calif.	4,500	Mar. 29	Bailey	
♀	Panamint Valley, Calif		Mar. 27	do	
♀	do		Apr. 20	do	
♂	do		do	do	
♂	do		do	do	
♀ jun.	do		Apr. 24	do	
♀ jun.	do		do	do	
♂	Owens Lake, Ash Creek, Calif	3,700	May 29	Stephens	
♀	Owens Valley, 10 miles north of Bishop, Calif.	4,200	July 1	do	
♂	Argus Range, Maturango Spring, Calif.		May 6	Fisher	
♀	do		do	do	

List of specimens of Phrynosoma platyrhinos—Continued.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18433	♀ jun.	Argus Range, Maturango Spring, Calif.	....	May 6	Fisher......	
18434	♂	Argus Range, Coso Valley, Calif..	....	May 11	....do	
18435	♀ jun.	Coso, Calif..........	....	May 19	Palmer	
18436	♂	Deep Spring Valley, Calif..........	5,400	June 9	Merriam....	
18437	♂	Lone Pine, Calif..........	....	June 5	Palmer	
18438	♂ jun.	......do	....	June 7	....do	
18439	♂	Independence, Calif..........	....	June 11	Bailey	
18440	♂	......do	....	..do	....do	
18441	♂	......do	....	June 18	Stephens ...	
18442	♀	Coyote Holes, 20 miles northeast of Daggett, Calif.	....	Mar. 13	Palmer	
18443	♂ juv.	Colorado Desert, Palm Spring, Calif	....	Sept. 27	Stephens ...	
18444	♀	(?)	....	(?)	(?)	Received from Death Valley Expedition, April 28, 1891.
18445	....	(?)	....	(?)	(?)	
18461	♂	Ash Meadows, Nev..........	....	Mar. 4	Nelson......	Pl. ii, fig. 4.

Family HELODERMATIDÆ.

Heloderma suspectum Cope.

It is curious that the exact range of so conspicuous and so far-famed a species as the Gila monster is still greatly in doubt. Southern Arizona seems to be the center of its distribution, and from there we have a number of well authenticated records based upon specimens, but as soon as we get outside of that Territory the records become uncertain, and the localities given are vague. Thus we have 'Mohave River' given by Baird upon the authority of Kennerly and Möllhausen (Pac. R. R. Rep., X, Whipple's R., Zoöl., p. 38) which would introduce the species into the Californian fauna, but no specimen seems to have been brought home, and the record remains dubious. Yarrow (Wheeler's Exp., W. 100 Mer., V, p. 562) states that it is "not uncommon in Utah, New Mexico, and Arizona" and that "several specimens were secured in 1871, 1873, and 1874, but with one exception (specimen from Arizona collected in 1873) all were lost in transit to Washington." The New Mexico record refers probably to the observation near San Ildefonso of "a large lizard, presumably of this species" by one of the packers. Whether specimens were actually secured in Utah, I don't know, nor has any other Utah record come to my certain knowledge.

It is therefore very interesting to note that Dr. Merriam found the dead carcass of a *Heloderma* near the Virgin River, in eastern Nevada, the first authentic record from that state.

The specimen was in too bad shape to be preserved, but two of the feet were cut off and brought home as evidence (No. 18640). As the fourth finger, without claw, measures 22^{mm}, it is plain that the specimen was one of large dimensions.

[One of the most unexpected discoveries made by the expedition was the finding of a Gila monster by Mr. Bailey and myself in the Valley of the Virgin, about 8 miles below Bunkerville, near the eastern boundary of Nevada, May 8, 1891. It was dead when found, and measured 475^{mm} (a little more than 18½ inches) in total length. We were told by the Mormons that the species occurs in the Lower Santa Clara Valley, in southwestern Utah, but is rare.—C. H. M.]

Family ANGUIDÆ.

G rrhonotus scincicauda (Skilton).

The question of the status of the various *Gerrhonoti* credited to California is one of the most difficult and most intricate in North American saurology, partly on account of the great amount of individual variation, partly because of the comparatively scanty, and in many respects unsatisfactory material. Yet, with about one hundred specimens before me, I am able to distinguish a number of separable forms. Nothing would be easier than to bring them all together under one name, and with only a limited number of specimens I might be tempted to do so, but the result would be very far from the truth, and by so doing we would only delay the true solution of the question instead of promoting it.

Let me first remark that I regard the Cape St. Lucas form separable, and that from Bocourt's rather detailed description of the type (Miss. Sc. Mex., Rept., livr. 5, 1878, pp. 357–359) I believe that it is entitled to the name *Gerrhonotus multicarinatus*. This form does not occur in Upper California, nor do I believe that it will be found in Lower California outside of the Cape region proper.

The next question relates to the name of the present form which inhabits, so far as the localities embraced in the present report are concerned, the chaparral belt of the San Joaquin Valley and of the San Jacinto and San Bernardino Mountains. I have so far been unable to make a distinction between the so-called *G. multicarinatus* of authors, from the State of California, *G. scincicauda*, and *G. grandis*, and as *G. scincicauda* is the oldest of these, I retain it for the present form, *i. e.*, the one with all the upper scales strongly carinated, the azygos prefrontal large, the body very elongated, and the coloration characterized by about nine continuous dark bands across the back. It is possible that Wiegmann's *G. cæruleus* (1828) may belong here, but without the exact locality of the type being known, and without an opportunity to examine the specimen, which moreover seems to be very abnormally colored, it would be very unwise to adopt that name.

The nomenclature of the other separable forms will be discussed further on under their respective heads.

According to Mr. T. S. Palmer, the present form is confined to the chaparral belt. Only two specimens were secured by the expedition.

List of specimens of Gerrhonotus scincicauda.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18616	♀	Three Rivers, Calif.	....	July 28	Fisher	
18617	♀	Kaweah River, East Fork, Calif.	3,600	July 27	Bailey	

Gerrhonotus scincicauda palmeri, subsp. nov.

Diagnosis.—Similar to *G. scincicauda*, but body much less elongated and coloration above essentially different, being, according to age and sex, either uniform dark olive brown with numerous black and white dots on the sides, or pale bluish drab clouded with numerous ill-defined and irregular blotches of brownish drab; blotches not arranged in cross bands.

Habitat.—High elevations of western slope of southern [only?] Sierra Nevada.

Type.—U. S. Nat. Mus., No. 18606 ♂ ad. South Fork Kings River, Calif., T. S. Palmer coll.

Most of the *Gerrhonoti* brought home by the expedition belong to this form, of which there is no specimen in the Museum collection from any definite and undoubted locality before, and all the specimens of the expedition were collected in a comparatively small area near the headwaters of the Kern, Kings, and Kaweah rivers, at an altitude of from about 7,000 to 9,000 feet above the sea.

It might seem strange that there should be no name available among the many defunct synonyms of Californian *Gerrhonoti* by which to distinguish this form, but the fact seems to be that most of the specimens so far brought to the notice of herpetologists have been collected in the lower altitudes, while the present form seems to be restricted to the higher altitudes of the Sierra.

The general aspect of this form is strikingly different from all the other Californian *Gerrhonoti*, and this difference is equally well marked in the youngest specimen and in the oldest. I have before me a nearly unbroken series of ten specimens, from a very young one, with a body only 40^{mm} long, up to the dark old males, and none of them can for an instant be mistaken for the typical *G. scincicauda* from the lower valleys. The whole figure is shorter and more thick set, and the broad and rather distant cross-bands on the back are conspicuously abrupt, the coloration being either uniform dark or else an ill-defined, often obscure, 'pepper-and-salt' mixture. Only in one specimen (No. 18612) there is a more definite arrangement of the light and dark spots, but these ill-defined cross-bands are much more numerous than in *G. scincicauda*, being about fifteen on the back (between anterior and posterior limbs) as against nine to ten in the latter. A similar pattern may also be traced in the youngest specimen referred to (No. 18613) with a similar result.

I take great pleasure in dedicating this interesting form to Mr. T. S. Palmer, who not only collected the type, but also assisted me materially in clearly pointing out the difference in distribution of the present form and its typical representative in the chaparral belt.

List of specimens of Gerrhonotus scincicauda palmeri.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	♂	South Fork King's River, Calif.			Palmer	Type.
[illegible]	♀	East Fork Kaweah River, Calif.	*8,800	Aug. 8	Bailey	
[illegible]	♀ juv.	do	*8,800	do	do	
[illegible]	♂ juv.	do	*8,500	Aug. 1	do	
[illegible]	♂	Soda Springs, North Fork Kern River, Calif.	7,200	Sept. 6	Nelson	
[illegible]	♀	do	7,200	do	do	
[illegible]	♀	North Fork Kern River, Calif.		Sept. 15	do	
[illegible]	♂ juv.	Soda Springs, North Fork Kern River, Calif.		Aug. 15	Bailey	
[illegible]	♀	Sequoia National Park, Calif.	*7,000	Aug. 2	Fisher	Near Kaweah saw-mill.
[illegible]	♀	Mineral King, Calif.	*8,800	Aug. 6	Bailey	

* About.

Gerrhonotus burnettii Gray.

I have no hesitation in declaring this form to be exactly the same as Baird and Girard's *G. formosus*, and a comparison of the excellent figure of the type of *G. burnettii* by Bocourt (Miss. Sc. Mex., Rept., livr. 5, 1878, Pl. XXI C. fig. 4–4 *a*) with that of the type of *G. formosus* in the atlas of the herpetology of the United States Exploring Expedition (Pl. XXIII, figs. 10 and 12) will at once substantiate this assertion. The essential characters consist in the comparatively short snout with its very arched profile, the great development of the paired prefrontals at the expense of the azygos prefrontal, which therefor is of small size, and the peculiar coloration, the dorsal cross-bands being broken up into three portions, one median and two lateral by two longitudinal lines which in some specimens are emphasized by being lighter than the ground color.

This form is only distantly related to *G. scincicauda*, but very closely to *Gerrhonotus principis*, so close, in fact, that I believe that the name of the latter will become reduced to a trinominal when the geographical distribution of the two forms shall have been ascertained in all its details. *G. burnettii* is now known to occur along the coast at least from Monterey to Humboldt Bay. How far inland it extends its range and how and where it meets or grades into *G. principis* is as yet undeterminable. One thing is certain, however, and that is, that the range of *G. burnetti* and *G. scincicauda* overlap considerably, and in this fact alone I see sufficient proof of their specific distinctness. The differences between them are certainly due neither to sexual, nor to seasonal, nor to individual variation, great as the latter is in the *Gerrhonoti*.

List of specimens of Gerrhonotus burnettii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18605	♂ jun.	Monterey, Calif.	....	Sept. 29	Bailey	

Family Xantusiidæ.

Xantusia vigilis Baird. (Pl. III, fig. 1).

The present species was described in 1858 by Prof. Baird from specimens sent home by Xantus from 'Fort Tejon,' Calif. Nothing has been published concerning it since then, and this, perhaps our most interesting lizard, has also been one of the rarest and supposed to possess a very restricted range.

Two additional specimens are now before us, one collected by Dr. Fisher at Hesperia, on the south side of the Mohave Desert, on January 4, 1891, while Mr. Palmer secured the other on February 24, in Pahrump Valley, Nevada, thus extending the range of the species nearly 200 miles eastward. The type locality, Fort Tejon, is in an open cañon—the celebrated Cañada de las Uvas of the early exploring expeditions—connecting the west end of the Mohave Desert with the San Joaquin Valley. The fauna and flora of this cañon present a mixture of Mohave Desert and interior valley forms.

In all probability this species is more or less nocturnal in habits, which may account for the scarcity of specimens collected.

Both specimens are somewhat larger than the largest of the types, and, judging from the condition of the femoral pores, I take them to be adults.

There appears to be some slight variation in the shape of the individual head shields and in the shape of the head, the Death Valley expedition specimens having it somewhat more elongate; but the differences are not greater than between the type specimens themselves.

List of specimens of Xantusia vigilis.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18618	....	Pahrump Valley, Nev	....	Feb. 24	Palmer	....
18619	....	Hesperia, Mohave Desert, Calif	3,200	Jan. 4	Fisher	Pl. III, fig. 1.

Family Tejidæ.

Cnemidophorus tigris B. & G.

All the *Cnemidophori* brought home by the expedition belong to one species, those from the deserts of the Great Basin in California, Nevada, and Utah being typical of the above name, while those from the great interior valley of California are referable to a subspecies, *C. tigris undulatus*.

Owing to the fact that nearly the entire collection of North American *Cnemidophori* are inaccessible to me at the present writing, I have been unable to settle the question as to the proper name of the present species to my own satisfaction. It may be that *C. tigris* is only a synonym pure and simple of *C. tesselatus* (Say) or they may be trinominally separable. I have therefore retained the name *C. tigris*, as the specimens before me agree perfectly with the type of the latter.

There is a great deal of individual variation in the amount of black markings and in their intensity, the dorsal pattern being quite distinct in some, while in others it looks as if it had faded out. On the other hand, the black suffusion on throat and breast is equally variable, but neither sex, age, season, nor locality seem to account for the variation, except that it is usually absent in the very youngest. In all the specimens the longitudinal striping is very evident, and, in fact, the difference between the general pattern in the only very young specimen collected (No. 18481) and the full-grown ones, apart from individual variation, is but very slight.

[The whip-tail lizard (*Cnemidophorus tigris*) is nearly as common as the gridiron-tail in much of the area traversed, but is not so strictly confined to the Lower Sonoran Zone, ranging up a short distance into the Upper Sonoran and consequently reaching some valleys in which the former species is absent. In this respect it resembles the leopard lizard (*Crotaphytus wislizenii*), with which it is usually found. It lives on the open desert and runs with great rapidity when alarmed.

In California it is abundant in the Mohave Desert, where it ranges westward through Antelope Valley to the Cañada de las Uvas (changing to subspecies *undulatus*), and southward in the wash leading from near Gorman station toward Peru Creek in the Sierra Liebré. In the open cañon leading up to Tehachapi Valley from the Mohave Desert it ranges all the way to the summit of the pass (at Cameron) and probably throughout Tehachapi Valley also, but was not seen there because of a severe cold wind, which lasted all day at the time we passed through. It ranges up from the Mohave Desert over Walker Pass and down on the west slope to the valley of Kern River, where it changes to subspecies *undulatus*. It is common in Owens Valley, and ranges thence up on the warm, west slope of the Inyo and White Mountains to 2,130 meters (7,000 feet) or higher, opposite Big Pine; and is tolerably common also in Deep Spring Valley. It is common in Panamint, Death, and Mesquite Valleys, ranging from the latter through Grapevine Cañon to Sarcobatus Flat. In Nevada it is common in the Amargosa, Pahrump, and Vegas Valleys, at the Bend of the Colorado, in the valleys of the Virgin and Muddy, and reaches Oasis, Pahranagat, Desert, and Meadow Creek Valleys, and from the latter ranges up among the junipers on the west slope of the Juniper Mountains, to an altitude of 1,980 meters (6,500 feet). In Utah it is common in the Lower Santa Clara Valley, and thence ranges northward to the Upper Santa Clara Crossing, but disappears before reaching Mountain Meadows.

The food of *Cnemidophorus tigris* consists of grasshoppers and other insects—no leaves or flowers were found in the numerous stomachs examined.—C. H. M.]

List of specimens of Cnemidophorus tigris.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18462	ad.	Santa Clara Valley, Utah		May 11	Merriam	
18463	♂	Pahrump Valley, Nev		Apr. 28	do	
18464	♂	do		Apr. 29	Bailey	
18465	ad.	Pahranagat Valley, Nev		May 25	Merriam	
18466	ad.	do		May 25	Bailey	
18467	ad.	Oasis Valley, Nev	4,600	June 2	do	
18468	adol.	Callville, Nev		May 4	do	
18469	♂	Coso Mountains, Coso, Calif		May 18	Fisher	
18470	♀	do		May 20	do	
18471	♂	Argus Range, Shepherd Cañon, Calif		Apr. 27	do	
18472	♂	do		Apr. 28	do	
18473	♀	do		Apr. 28	do	
18474	♂ juv.	do		Apr. 28	do	
18475	♂	Argus Range, Coso Valley, Calif		May 11	do	
18476	♂	Argus Range, Searl's Garden, Calif		Apr. 24	Stephens	
18477	ad.	Panamint Mountains, Willow Creek, Calif.	4,600	May 18	Nelson	
18478	♂	Panamint Valley, Hot Springs, Calif.		Apr. 22	Merriam	
18479	ad.	Lone Pine, Calif		June 11	Fisher	
18480	ad.	do		June 6	Palmer	
18481	juv.	Death Valley, Calif		Mch. 22	Nelson	
18482	ad.	Death Valley, Furnace Creek, Calif		June 20	Fisher	
18483	jun.	do		Jan. 29	do	
18484	ad.	do		Apr. 10	Merriam	
18485	ad.	Death Valley Bennett Wells, Calif		Apr. 1	Bailey	
18486	ad.	do		do	do	
18487	ad.	do		Apr. 4	do	
18488	ad.	do		do	do	
18489	jun.	do		Jan. 22	do	
18490	♂	Mohave Desert, Leach Pt. Valley, Calif.		Apr. 25	Merriam	
18491	♀	do		do	do	
18492	♀	Owens Lake, mouth of cañon 5 miles southwest of Olancha, Calif.	4,000	June 8	Stephens	
18493	♀	Owens Lake, Olancha, Calif	3,700	May 19	do	
18494	ad.	Deep Spring Valley, Calif	5,300	June 9	Merriam	

Cnemidophorus tigris undulatus (Hallow).

Ten specimens from the west slope of the Sierra Nevada differ so much from the desert specimens that I must regard them as entitled to a separate trinominal appellation. So far as I can see there is no structural difference, nor is there a very radical difference in the color or the pattern. The latter is considerably coarser, better defined, and deeper in color. The difference between the two forms in this respect is particularly well marked on the sides of the head, the dark marks being nearly obsolete in the desert form, while in the latter the slate-colored suffusion on the under side seems to be the rule. I have yet to see a specimen from the great interior valley of California in which it is present.

As to the name of this form, I have to remark that the specimens have been carefully compared and found identical with Hallowell's type specimen. It will be observed that in the original description (Pr. Phil. Ac., 1854, p. 94) the locality of the type is stated to be "near Fort Yuma, in San Joaquin Valley," but the self-contradiction of this statement is explained by the fact that Fort Miller, Fresno County, is meant, and not Fort Yuma, on the Colorado River (cf. Heermann's list in Pac. R. R. Rep., X, Williamson's Route, Zoöl., Rept., p. 24).

Two very young specimens of this form (No. 18503 and 18504), which are quite alike, differ considerably from the typical Death Valley specimen (No. 18481) of precisely the same size. In the latter the three median dark dorsal bands are more or less broken up by light spots adjacent to the light stripes, while in the young *C. undulatus* these bands are well defined and uniform blackish. It would therefore seem that, while there is but little difference between adult and young in the former, the young of the latter are considerably different from the adults.

[This subspecies replaces the typical *C. tigris* on the west or coast slope of the Sierra Nevada in California, where it was found from Kernville south to Havilah and Walker Basin, and north to Three Rivers and the East Fork of Kaweah River. It was collected also in the Cañada de las Uvas, near Old Fort Tejon. The range of *C. tigris* seems to be continuous with that of *C. tigris undulatus* through the three low passes by which communication is established between the Mohave Desert and the upper San Joaquin Valley—namely Walker and Tehachapi Passes and the Cañada de las Uvas.—C. H. M.]

List of specimens of Cnemidophorus tigris undulatus.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	ad.	East Fork, Kaweah River, Calif	5,600	July 29	Bailey	
[illegible]	ad.	Walker Basin, Calif		July 14	Fisher	
[illegible]	ad.	do		do	do	
[illegible]	ad.	Old Fort Tejon, Calif		July 7	Palmer	
[illegible]	ad.	Kernville, Calif		June 23	do	
[illegible]	ad.	do		do	do	
[illegible]	adul.	South Fork, Kern River, Calif	2,750	July 7	Bailey	
[illegible]	ad.	Three Rivers, Calif		July 28	Palmer	
[illegible]	juv.	do		Sep. 16	Bailey	
18504	juv.	do		Sep. 14	do	

Family SCINCIDÆ.

Eumeces skiltonianus (B. & G.).

The extent of variation in color, scale formula, and proportions is well illustrated by the material brought home by the expedition. Thus in the two examples from Maturango Spring in the Argus Range, both quite adult and nearly of the same size, one (No. 18598) is nearly uniformly brownish-gray above, with hardly a trace of dark stripes, while in the other (No. 18599) the longitudinal stripes are quite visible, though the ground color is nearly the same; the former has the head greatly swollen at the temples and has 24 rows of scales round the middle of the body, while the latter has the head narrow and 26 scale rows; moreover, in the former the limbs are overlapping when pressed against the body, a character relied upon by Boulenger for separating *E. skiltonianus*, etc., from *E. leptogrammus*, while in the last mentioned specimen the limbs do not meet by the length of several scales, in the latter character agreeing with No. 18600 from the Panamint Mountains. Both specimens from Old Fort Tejon are uniformly brownish-gray, one (No. 18603) considerably paler than the other, both with swollen temples. No. 18601 is colored like the latter, but has a very long tail, and has, moreover, the frontal in contact with the azygos prefrontal.

All the specimens have two azygos postmentals, but in the collection of the National Museum there is plenty of material to show that Bocourt's *Eumeces hallowelli*, the distinguishing character of which is the single postmental, is nothing but an individual variation of *E. skiltonianus*.

It is interesting to note that *E. skiltonianus*, as it grows old, is subject to the same swelling of the head at the temples and the concomitant disappearance of the striped pattern as well as the loss of the blue color of the tail, as *Eumeces fasciatus*.

A glance at the subjoined list of specimens shows that the expedition has materially extended our knowledge of the geographical distribution of this species, all the specimens previously recorded having been obtained within the Pacific slope, while now we have specimens both from the Argus Range and the Panamint Mountains. It is evident, however, that it is not a species of the desert plains or valleys.

[Specimens of this small lizard were obtained in the Panamint and Argus ranges in the Great Basin, and in Kern River Valley and the Cañada de las Uvas (near Old Fort Tejon) on the coastal slope of the Great Divide in California.—C. H. M.]

List of specimens of Eumeces skiltonianus.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18598	ad.	Argus Range, Maturango Spring, Calif.	....	May 8	Fisher	
18599	ad.	......do	....	May 3	....do	
18600	adol.	Panamint Mountains, head of Willow Creek, Calif	*7,000	May 10	Nelson	
18601	ad.	Kern River, 25 miles above Kernville, Calif.	....	July 4	Fisher	
18602	juv.	Soda Springs, North Fork Kern River, Calif.	....	Aug. 15	Bailey	
18603	ad.	Old Fort Tejon, Calif	....	July 5	Palmer	
18604	ad.	......do	....	July 8	....do	

*About.

Suborder II. *OPHIDIA.*

Family LEPTOTYPHLOPIDÆ.

Rena humilis B. & G.

A single specimen (No. 18686) was collected in Death Valley, 6 miles from Bennett Wells, by Mr. Palmer, March 25. This is the most northern record of the species as well as of the family *Leptotyphlopidæ* in North America. The type of this species came from the Colorado Desert.

Family BOIDÆ.

Charina plumbea (B. & G.).

The specimen (No. 18685) which Dr. Fisher collected in Redwood Cañon, on the East Fork of the Kaweah River, September 12, 1891, is entirely within the limits of the extraordinary variation of this species demonstrated by me some time ago (Proc. U. S. Nat. Mus., XIII, 1890, p. 177 seqv.), and does not in any way approach either *Ch. bottæ* or *Ch. brachyops*. It has forty-five scale rows, posterior nasal not in contact with anteorbital; prefrontals not entering orbits; one loreal, four prefrontals, no internasals, one anteorbital, one supraorbital, three to four postorbitals, no suborbitals, two to three labials in contact with eye.

Prof. Cope has recently (Proc. U. S. Nat. Mus., XIV, 1891, p. 593) discussed the status of *Ch. plumbea* and *bottæ*, without the slightest reference however to my paper quoted above, and comes to the conclusion that both are identical, chiefly, it seems, on the ground that when he, himself, in 1864, examined the alleged type of de Blainville's *Ch. bottæ* he counted forty-three scale rows. It will be remembered that I retained the two species for the reason that both Jan and Bocourt count thirty-nine scale rows as against a minimum of forty-three in twenty specimens of *Ch. plumbea*.* There seems to be good ground for doubting that the specimen which Cope examined really was the type and the same specimen which Jan and Bocourt have described and figured in detail. Moreover, some of Prof. Cope's notes concerning this matter (*l. c.*) are not calculated to inspire confidence in the exactness of all the statements.

Consequently I can see no reason for changing my views of three years ago, viz, that there is as yet no good reason for uniting the two species.

Family NATRICIDÆ.

Diadophis pulchellus B. & G.

I have seen no intergradation between this form and *D. amabilis* which would justify a trinominal appellation for the present.

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*Cope (*l. c.*) calls attention to Bocourt's lapsus of giving twenty-nine scale rows. That it is a lapsus is evident from Bocourt's comparison of the two species, in which he distinctly credits *Ch. bottæ* with thirty-nine.

The only specimen (No. 18684) collected is typical in coloration and within the known range of this form. It was obtained by Mr. E. W. Nelson in Yosemite Valley, California, August 7, 1891.

Lampropeltis boylii (B. & G).

The six specimens brought home by the expedition give no occasion for any extended remarks, as they are quite typical in every respect, with no leaning toward var. *conjuncta* Cope, from Cape St. Lucas and Yuma; *californæ* Blainville, from San Diego, or *eisenii* Yarrow, from Fresno.

The two Nevada specimens differ from those from California in having the frontal longer than the interparietal suture, but in a lot of true *L. boylii* from Fresno (U. S. Nat. Mus. No. 11787) I find a specimen exactly like the above from Nevada.

[This large and conspicuous snake, whose cream colored body is sharply marked by rings of black, was first found in the Valley of the Lower Muddy near an abandoned mill at Overton, Nevada, where several were secured in dense thickets of *Atriplex torreyi*. About dark they began to emerge from these retreats, making a great noise in crawling over the dry leaves, and were soon found in the open. The species was obtained also in Pahranagat Valley, Nevada, a little north of the middle of the valley. On the west slope of the Sierra Nevada, in California, specimens were collected in Kern Valley, at Three Rivers, and on the east fork of Kaweah River.—C. H. M.]

List of specimens of Lampropeltis boylii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18090	....	Three Rivers, Calif.	....	July 27	Palmer	
18091	....	......do	....	...do...	Fisher	
18092	....	South fork, Kern River, 25 miles above Kernville, Calif.	....	July 9	....do	
18093	juv.	East fork, Kaweah River, Calif.	1,700	July 27	Bailey	
18094	....	Overton, Muddy Valley, Nevada	....	May 6	Merriam	
18095	....	......do	....	....do...	Bailey	

Hypsiglena ochrorhynchus Cope.

The only specimen obtained by the expedition was collected by Dr. A. K. Fisher in Shepherd Cañon, in the Argus Range, California, April 24, 1891. It (No. 18071) is somewhat peculiar on account of the small size of the dorsal spots, though otherwise it agrees well with the types from Cape St. Lucas, Lower California, as well as with a number of specimens from Arizona. The characters pointed out by Cope as distinguishing *H. chlorophæa*, types from Fort Buchanan, southern Arizona, are so variable in the specimens before me that they will not serve the purpose. I am not quite prepared to give up the latter species as yet, inasmuch as the type specimen (U. S. Nat. Mus., No.

4676; only one specimen is now in the collection) has no pseudopreocular, a character only shared by a specimen from the city of Chihuahua, Mexico (U. S. Nat. Mus. No., 14287), while it is present in all the other specimens. These two specimens, therefore, I shall continue to call *H. chlorophæa* until it be shown that the absence of the pseudopreocular is only an individual variation.

The specimen collected by the expedition adds a new species to the fauna of the State of California, if I am not mistaken.

Assuming, for the present at least, the distinctness of *H. chlorophæa*, we would have three species or forms within the United States, including an undescribed species from southwestern Texas,* which may be distinguished as follows:

a. Upper surface of head flat.
  b. No pseudopreocular .... *H. chlorophæa.*
  bb. Pseudopreocular present .... *H. ochrorhynchus.*
aa. Upper surface of head convex .... *H. texana.*

Salvadora grahamiæ hexalepis Cope. (Pl. III, fig. 2).

The four specimens collected by the expedition belong to this form, as I now understand it, that is to say, to the form which possesses at least one true subocular (by this term excluding the subpreocular, or pseudopreocular). One of the specimens (No. 18062 Virgin River, Nevada) possesses only one subocular (anterior), and agrees in this respect perfectly with specimens from Fort Whipple, Arizona (type locality); Mohave Villages, Arizona; Cottonwood Cañon, Utah, and Valle de la Viejas, San Diego County, California. The three other specimens, however, differ from all the other specimens I have seen in also having a posterior subocular, thus isolating the eye entirely from the labials.

The individual variation in this species is too great, however, to allow a subdivision on these lines without a much greater material to support it. There is evidently a tendency towards dividing up the labials transversely in the region indicated by the localities mentioned above, and as this subdivision seems to be proportionate to the greater width of the rostral, it would be natural to conclude that the two characters may have a common origin. The fact that these localities are the most arid of all those from which I have specimens of *Salvadora* is very suggestive, since these snakes to a great extent live in holes in the ground.

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* Hypsiglena texana, sp. n.

Diagnosis.—Similar to *H. ochrorhynchus*, but with the upper surface of the head convex, the lateral outline of the frontal curved outward, and the dark eye stripe covering more than upper half of the sixth supralabial.

Scale rows, 21; gastrosteges, 175; urosteges, 43; supralabials, 8; preoculars, 1; pseudopreoculars, 1; postoculars, 2; temporals, 1.

Type.—U. S. Nat. Mus., No. 1782; between Laredo and Camargo, Tex.; U. S. Mex. Bound. Surv., Arthur Schott, coll.

Habitat.—Southwestern Texas

In addition to the type specimen the museum possesses two other specimens, one collected by Mr. W. Taylor at San Diego, Texas (U. S. Nat. Mus., No. 15672), and one by Mr. Butcher at *Laredo (No. 7124). Both agree in every respect with the type.*

The gradation of this form into *S. grahamiæ*, without suboculars, is shown by a specimen collected by Dr. Edward Palmer at St. Thomas, Nev. (U. S. Nat. Mus. No. 15616), which has one on one side but none on the other.

[St. Thomas is less than 30 miles from the point where my specimen (No. 18062) was collected, and is in the same valley.—C. H. M.].

List of specimens of Salvadora grahamiæ hexalepis.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18059	....	Argus Range, Shepherd Cañon, Calif.	....	Apr. 26	Fisher......	....
18060	....	Argus Range, Maturango Spring, Calif.	....	May 2	....do.......	Pl. III, fig. 2.
18061	....	Amargosa Borax Works, Calif.....	....	Mar. 16	Palmer	1,000 feet above the Amargosa river.
18062	....	Virgin River, near Bunkerville, Nev.	....	May 8	Merriam ...	....

Pituophis catenifer (Blainv.).

The only two specimens which I can refer to the typical form of this species are from the coastal or west slope of the Sierra Nevada, and from Old Fort Tejon, in the Cañada de las Uvas, California, and are better recognized as such by their coloration and general aspect than by any exclusive structural character. True, the carination of the scales is weak and the eight outer scales are smooth in both, but the character derived from the carination is a very elusive one, as will be demonstrated under the heading of the next form, and can not alone be relied upon to define these very difficult and variable snakes.

List of specimens of Pituophis catenifer.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18063	....	South Fork Kings River, Calif......	8,000	Aug. 17	Palmer	Bubb's Creek.
18064	....	Old Fort Tejon, Calif................	....	July 8	....do.......	

Pituophis catenifer deserticola, subsp. nov.

By this name I propose to designate the form usually called *P. bellona*, or *P. sayi bellona*, as there can be no doubt that Baird's and Girard's, original *Churchillia bellona*, which came from Presidio del Norte, Chihuahua, Mexico, was a typical *P. sayi*. The type appears now to be lost, but I have before me a specimen from the identical locality (U. S. Nat. Mus. No. 1542) with a most pronouncedly narrow rostral and agreeing with *P. sayi* in all other respects also. Of all the later names applied to various forms or individuals of the present species none seem to have been based upon the richly-colored form from the Great Basin and the southwestern deserts, which agrees with true *P. catenifer* in having a broad and low rostral. That Baird and Girard later referred specimens of this form to *P. bellona* can not, of course, justify the shifting of this name to another type.

As a general rule this form has a more pronounced carination of the scales and a less number of smooth scales on the sides, but this character can not be relied upon at all, and whether a specimen shall be referred to either typical *P. catenifer* or to this desert form must be decided upon the totality of the characters, as a reliance upon the carination leads to very erroneous results. This will be plain at once to any one who will take the trouble to examine and compare the descriptions of the various species described by Baird and Girard in their Catalogue of North American Serpents, and as I have examined a number of their specimens I am able to state that the descriptions are generally correct. It will then be found that these Pacific coast specimens have only three to five outer rows perfectly smooth, while as synonyms of *P. catenifer*, the types of *P. wilkesii*, etc., 'ought' to have nine rows of smooth lateral scales. Again, both types of *P. mcclellanii* which 'ought' to have only five smooth rows, because being true *P. sayi*, have at least seven smooth rows. Furthermore, it has been asserted that the typical *P. catenifer* occurs as far east as Pyrmont,* Nev., upon the strength of U. S. National Museum No. 8139. This number contains two specimens so alike otherwise as to preclude the possibility of their belonging to two different species. Why they should be referred to *P. catenifer* I can not discover, for one has only three perfectly smooth scale rows, while in the other the number is four or five. On the other hand, of two specimens in the present collection, both from the Panamint Mountains, Calif. (Nos. 18065 and 18066), one has only four rows of smooth scales on each side, while the other has ten. In every other respect the two are practically alike and no one could reasonably refer them to two different species. Yet that would have to be done were we to use the number of smooth scale rows as a character.

[This subspecies, according to Mr. Stejneger, is the form inhabiting the Great Basin, while, as pointed out above, typical *P. catenifer* is restricted to the coastal slope of California.

On the east side of Pahrump Valley, Nevada, one of these snakes measuring 5 feet in length was killed April 29, among the tree yuccas along the upper edge of the *Larrea* belt, at an altitude of 1,340 meters

* The name 'Pyrmont' appears in the Rept. Wheeler Survey, v, 1875, Zoölogy, p. 541, the specimens referred to having been taken there by the Wheeler Expedition of 1872. This is probably the same place as *Piermont*, which is given on map sheet No. 59 of the Wheeler Survey, and on the 'Map of California and Nevada with Parts of Utah and Arizona,' published by the Chief of Engineers, U. S. Army, 1879. Piermont is on the west side of Spring Valley and on the east slope of the Shell Creek Range. It is in White Pine County, Nev., about 75 miles due east of the town of Eureka.

(4,400 feet). Another was obtained on the east slope of the Beaverdam mountains, in southwestern Utah, May 11.

In California, specimens were obtained at Lone Pine and Haway Meadows in Owens Valley, and in the Panamint and Argus mountains.—C. H. M.]

List of specimens of Pituophis catenifer deserticola.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18065	....	Panamint Mountains, Jackass Spring, Calif.	....	May 7	Nelson....	
18066	....	Surprise Cañon, Calif.	....	April 23	Fisher....	
18067	....	Argus Range, Shepherd Cañon, Calif	....	April 26	....do	
18068	....	Ten miles south of Owens Lake, Calif	3,750	May 12	Stephens .	Haway Meadows.
18069	....	Owens Valley (Lone Pine), Calif.....	....	June 4	Fisher....	
16070	....	Beaverdam Mountain, Utah..........	....	May 11	Merriam ..	

Bascanion flagellum frenatum, subsp. nov.

Diagnosis.—Adults with permanent brownish or blackish bars across the nape; young with a distinct whitish line from nostrils through eye and across temporals, this stripe often persistent in adults; chin and throat speckled with blackish.

Habitat.—Southern Arizona, Utah, Nevada, California, and Lower California.

Type.—U. S. National Museum, No. 16340. Mountain Spring, Colorado Desert, San Diego County, Calif.; C. R. Orcutt coll.

There is no good reason why the various geographical forms of *Bascanion flagellum* should not be recognized by name, inasmuch as they are well marked, fairly constant, and characteristic of circumscribed geographical areas.

It is somewhat doubtful whether the form from the Cape St. Lucas region should not be recognized by a separate name also, but the material at hand is too scant to warrant any separation for the present.

Say's *Coluber testaceus*, the adults of which are uniform above, is apparently confined to the country east of the Rocky Mountains, and the name inapplicable to the form so strongly marked, as indicated in the diagnosis above. In the search for a possible name among the various synonyms I was led to examine the type of Baird and Girard's *Masticophis mormon* (U. S. Nat. Mus., No. 2012), from the Great Salt Lake, in the hope that it might be available for the present form, since it is sometimes found quoted in the synonymies of '*Bascanium testaceum*,' but it proved to be a young *B. flaviventre*, and a new name had consequently to be adopted.

This species was not collected by the expedition in the interior valley of California, but specimens in the U. S. National Museum from various localities show that it occurs there.

The present form has undoubtedly as much right to a separate name as *Bascanion piceum* Cope, the chief character of which, in addition to the uniform dusky coloration above, seems to be the nineteen scale-rows of the type and only specimen hitherto recorded, against the normal seventeen rows in *B. flagellum* and its allies. I have, however, before me a specimen (U. S. Nat. Mus., No. 17950) collected by Mr. P. L. Jouy, near Tucson, Ariz., which, though evidently by color a *B. piceum*, has only seventeen scale rows.

Of the specimens collected, No. 18088 is particularly interesting, as having an undivided anal. The fact that an undivided anal has been observed several times in *B. flagellum* and allies is quite an argument in their favor who would not attribute 'generic value' *per se* to the division or nondivision of the anal plate.

List of specimens of Bascanion flagellum frenatum.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	....	Overton (Muddy Valley), Nev	....	May 6	Merriam	
[illegible]	....	Vegas Valley, Nev	....	May 1	...do	
[illegible]	jun.	Death Valley, Bennett Wells, Calif.	....	Jan. 21	Nelson	
[illegible]	.....	Death Valley, Furnace Creek, Calif.	....	June 20	Fisher	
[illegible]	jun.	Panamint Valley, Calif	4,100	May 15	Nelson	
[illegible]	....	Panamint Valley, Hot Springs, Calif.	....	Apr. 22	Merriam	*Sitomys* in stomach.
[illegible]	......	Colorado Desert, Palm Springs, Calif.	....	Sept. 27	Stephens ...	
[illegible]	....	Keeler, Owens Lake, Calif	....	June 12	Palmer	Killed in a cellar.
[illegible]	....	Deep Spring Valley, Calif	....	June 9	Merriam	Head only.

Bascanion laterale (Hallow.).

Three typical specimens were collected on the west or coastal slope of the Sierra Nevada and Tejon Range, California, and one from the western slope of the Coast Range, in San Diego County, Calif.

This species seems to be comparatively rare, and considerable additional material is necessary to enable us to satisfactorily map out its geographical distribution.

List of specimens of Bascanion laterale.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	....	Old Fort Tejon, Calif		July 2	Palmer	
[illegible]	....	Three Rivers, Calif	850	Sept. 14	Bailey	
[illegible]	......	Walker Pass, west slope, Calif		July 3	Fisher	
[illegible]	....	Santa Ysabel, Calif		Oct. 6	Stephens ...	

Bascanion tæniatum (Hallow.).

The range of the present species is somewhat better understood than that of *B. laterale*. It is much more widely distributed, as specimens have been taken in Idaho, Utah, Nevada, California, Arizona, New Mexico, and Mexico, but it does not seem to reach the coast, nor does it appear to occur in the Valley of California, except at two points. These are Walker Basin (U. S. Nat. Mus., No. 9498) and Shasta County, northern California, where it probably enters by way of the Pit River Valley, as one specimen is from Baird, on the McCloud River (U. S. Nat. Mus., No. 13618), the other from Canoe Creek (No. 1983), both tributaries of Pit River.

List of specimens of Bascanion tæniatum.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18072	....	Argus Range, Maturango Spring, Calif.	....	May 4	Fisher	
18073	....	Coso Valley, Calif.	....	May 5	Do	
18074	....	Coso Valley, near Maturango Spring, Calif.	....	May 11	Palmer	
18075	....	Coso Mountains, Coso, Calif.	....	May 18	Fisher	
18076	....	Panamint Mountains, Willow Creek, Calif.	5,400	May, 19	Nelson......	

Thamnophis* infernalis (Blainv.).

The status of the various forms of garter snakes in North America is one of the most difficult problems, and as yet an unsolved one. Much more material than is at present available will be necessary in order to establish the limits of the species and subspecies, to define their characters, to ascertain the range of individual variation within each form, and to settle the many knotty points of nomenclature. For the present, the reference of many specimens must necessarily be a provisional one, and individuals which one herpetologist might identify as belonging to one form are very likely to be named quite differently by another, and our knowledge of the geographical distribution of a number of these forms must consequently also be defective. It would therefore hardly be wise to make any generalizations in this direction. Under such circumstances, when the limits and true characters of the various forms are yet unsettled, it seems unnecessary to make an attempt at recognizing a distinction between specific and subspecific terms. With

* According to the A. O. U. Code of Zoölogical Nomenclature (canon XLII), *Thamnophis* Fitzinger, 1843 (type *Th. saurita*), takes the precedence over *Eutainia* Baird & Girard. Apropos of my introduction of *Leptotyphlops* of Fitzinger for *Stenostoma*, preoccupied, it has been asserted that Fitzinger's names are *nomina nuda*. The simple fact that Fitzinger expressly indicated the type of the genus at once removes them from that category, and moreover, the code referred to states in so many words that the indication of the type species is sufficient for the establishment of the generic term.

this proviso I shall designate the forms which I have recognized among the material of the Death Valley Expedition by binominals.

Whether the form called *Eutainia infernalis* by Baird and Girard, and later by Prof. Cope, really is the same as Blainville's *Coluber infernalis* is to me a question which even Bocourt's recent paper (Bull. Soc. Zool. France, XVII, Jan. 26, 1892, p. 40) fails to settle, because he evidently includes several forms which we on this side of the Atlantic would not think of uniting. As the four specimens before me (Nos. 18711–18714) agree with the specimens which are usually called *E. infernalis*, I have adopted this term for the present.

Two of these specimens have nineteen scale-rows and eight supralabials (Nos. 18711, 18712), and all are uniform dark above with three well-defined buff-colored bands. No. 18711, the larger specimen, has the supralabials well bordered with blackish, while in No. 18712 these marks are obsolete. The latter is somewhat abnormal in having the second row of temporals fused together. The two specimens from Morro (Nos. 18713–18714), on the other hand, have twenty-one scale-rows and the labials (eight) well bordered with black.

List of specimens of Thamnophis infernalis.

U.S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18711	ad.	San Joaquin River, High Sierra, Calif.	8,100	July 29	Nelson	Near Mammoth Pass.
18712		Monterey, Calif		Oct. 5	Bailey	
18713		Morro, San Luis Obispo County, Calif		Nov. 10	Nelson	
18714		do		do	do	

Thamnophis elegans (B. & G.).

Of the three specimens which I refer to this species, the large one (No. 18708) is strikingly like the type of Baird and Girard. The number of scale-rows, however, is only nineteen, as in Baird and Girard's second specimen. The eye is somewhat larger, and the posterior supralabials lower, but in both respects it agrees closely with No. 878, from Fort Reading, Calif., which has always been referred to *T. elegans* without hesitation. In the two younger specimens, from Mount Whitney (Nos. 18709 and 18710), the general color is slightly more olive, not quite so bluish, and the labials are margined with blackish, in this respect resembling No. 878, referred to above. I do not believe that too much stress should be laid upon the absence or presence of these marks in this and allied forms. But instead of having the space between the dorsal and lateral stripes uniform dark, as in the larger specimen, these younger ones are distinctly spotted on a rather dark ground, quite resembling the subspecies recently described by Cope as *T. elegans lineolata*. An examination of No. 878, however, establishes the fact that the dorsal spots are *present* and that consequently the absence or presence of spots is only due to the darker or lighter shade of the ground color.

A great amount of collecting and observing will have to be done before we can know anything definite about the individual variation of these snakes. Each species and form will have to be investigated by itself, for it is plain that conclusions based upon analogies from allied forms are not to be relied upon, and it seems as if the only safe way would be to commence an examination on as large a scale as possible of the unborn young, cut out of the mother snake. A careful and detailed record of such examinations would settle many a mooted point, and is recommended to the attention of California naturalists.

List of specimens of Thamnophis elegans.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18708	ad.	Yosemite Valley, Calif.	4,000	Aug. 6	Nelson	
18709		10 miles south of Mount Whitney, Calif.		Aug. 31	Dutcher	
18710		do		do	do	

Thamnophis hammondii (Kenn.).

Fortunately there attaches no doubt to specimens belonging to this well defined species, and all here referred to it are typical in every way, scutellation as well as coloration. Its range overlaps to a great extent that of *Th. vagrans* without affecting the purity of the type, and as both are found in the identical localities, as well proved by the present collection, there seems no valid reason for regarding them as subspecies of the same species. The distinctive characters of this form are well pointed out and emphasized by Kennicott in the original description.

Neither does there seem to be any good reason for substituting the name *Th. couchii* for that of *Th. hammondii*. The two forms have been considered distinct up to the present time, and there has been collected no additional material of recent years which could tend to show that they are identical.

The twelve specimens of *Th. hammondii* contained in the present collection show a great constancy of some of the structural characters. All have twenty-one scale rows, eight supralabials, and one preocular.

In nearly all of them there are distinct indications of a dorsal band which in No. 18691, a young specimen, is quite well marked the whole length of the animal, while in most others it is chiefly developed on the portion nearest to the head.

List of specimens of Thamnophis hammondii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	♀ ad.	Owens Valley, Alvord, Calif	4,000	June 27	Stephens	
[illegible]	ad.	Owens Valley, Fish Slough, 10 miles north of Bishop, Calif.		July 2	do	
[illegible]	♀ ad.	Owens Lake, Cartago, Calif	3,700	June 10	do	
[illegible]		Old Fort Tejon, Calif		July 3	Palmer	
[illegible]	juv.	Lone Pine, Calif		Aug. 21	Fisher	
[illegible]	jun.	Kern River, 25 miles above Kernville, Calif.		July 9	do	South Fork.
[illegible]	jun.	do		July 5	do	
[illegible]	jun.	Kern River, South Fork, Calif		July 7	do	
[illegible]	ad.	Kern River, Calif	7,200	Sept. 8	Nelson	
[illegible]		Kern River, South Fork, Calif	2,700	June 22	Palmer	
[illegible]	ad.	Soda Springs, Kern River, Calif		Sept. 4	Fisher	
[illegible]	jun.	do		Aug. 14	Bailey	

Thamnophis vagrans (B. & G.).

The material brought home by the Death Valley Expedition seems clearly to demonstrate the impracticability of recognizing a subspecies *lineolata*. Among the specimens from southern California there are specimens which are typical and unquestionable *Th. vagrans* (for instance, No. 18706), which combine all the characters of this species, both as to scutellation and coloration. Practically from the same locality we have another specimen (No. 18707), which might properly be referred to *Th. lineolata*. Those from Soda Springs on the North Fork of Kern River, and Whitney Creek are more like the former than the latter, while the light-colored specimen from Ash Meadows, Nevada (No. 18700), is a true *vagrans*, so far as its dorsal spots are concerned, but a *lineolata* if we pay attention to the dorsal stripe only.

The other specimen from this latter locality (No. 18701) is abnormal in several respects, it being quite melanistic in coloration with a well-defined dorsal band. The dorsal scale rows are very irregular, so that it is difficult to make out the exact scale formula, but the prevailing number seems to be nineteen.

The amount of black on the belly is very variable; in fact, not two specimens are alike in this respect. No. 18707, from Lone Pine, has no trace of it, while No. 18706, from practically the same locality, Owens Lake, has the anterior half of each gastrostege black, and No. 18704, from Soda Springs, has the middle of the under side almost solid bluish black.

List of specimens of Thamnophis vagrans.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18699	....	Silver Creek, Nev	....	Nov. 8, 1890	Bailey	
18700	....	Ash Meadows, Nev	....	Mar. 3, 1891	Palmer	
18701	....	......do	....	Mar. 4, 1891	....do	
18702	....	North Fork, Kern River, Calif	....	Sept. 12, 1891	....do	
18703	juv.	......do	7,000	Sept. 10, 1891	Nelson	
18704	juv.	Soda Springs, North Fork, Kern River, Calif.	....	Aug. 15, 1891	Bailey	
18705	....	Whitney Creek, Calif	8,500	Sept. 5, 1891	....do	
18706	....	Owens River, Calif	6,000	July 20, 1891	Nelson	
18707	....	Lone Pine, Calif	....	June 11, 1891	Palmer	

Thamnophis parietalis (Say).

A single specimen (No. 18715) from Horse Corral Meadows, Fresno County, Calif., collected by Dr. A. K. Fisher, August 10, 1891, having nineteen scale rows, seven supralabials, and one preocular, has been referred to the present form in spite of the fact that the superior spots along the dorsal stripe are not fused into a solid black band. I have, however, before me a specimen from San Francisco (No. 893), referred to *Th. parietalis* by Cope, which in this respect agrees with the present specimen, but the dorsal is broader. On the other hand our specimen presents many points of resemblance to so-called *Th. leptocephala*, but I am unable to distinguish specimens of the latter with the above scale formula from specimens of the *Th. sirtalis* group. I have failed so far to distinguish any specific difference between *Th. sirtalis* and *leptocephala*, and am inclined to think that the latter is made up of similarly degenerate specimens belonging to different species or forms.

Family CROTALIDÆ.

Crotalus tigris Kenn.

The 'tiger-rattler,' of which the expedition has brought home quite a series, is one of the rarest species in collections. Discovered during the survey of the boundary between the United States and Mexico, and described by Kennicott, the habitat of the species was given in general terms as "Deserts of Gila and Colorado," but I can find no evidence of specimens recorded from anywhere except from the Sierra del Pozo Verde,* in Arizona. A specimen was afterwards collected by Dr. Irwin at Fort Buchanan, Ariz., and recorded by Dr. Yarrow in his

*The name is written both Sierra del Pozo Verde and Sierra Verde in the Rept. U. S. and Mex. Bound. Surv. (cf. vol. I, pt. I, p. 121 and pt. II, p. 70). This range is situated on the boundary between Arizona and Sonora, nearly due south of Baboquivari Peak, and about 50 miles northwest of Nogales. A spring known as 'Agua del Pozo Verde (Green Well)' is situated at the foot of the western slope near the southern end of the range.

Catalogue of the Reptiles and Batrachians in the U. S. National Museum (No. 5271). Dr. J. G. Cooper has since enumerated *C. tigris* from the California side of the 'Colorado Valley,'* but whether he based his record upon specimens actually collected (in which case, probably near Fort Mohave), or only upon the general statement in the report of the Mexican Boundary Survey, I do not know.

It does not appear to have been collected by any of the many parties of the Pacific Railroad Surveys, nor was it brought home by the herpetologists of the Wheeler Expedition west of the one hundredth meridian.

The extension of its known range by the present expedition is therefore very material, and is the more interesting since it was found almost over the entire desert area visited. So far from being restricted to the Colorado Valley proper, as surmised by Dr. Cooper, it seems to be chiefly confined to the desert mountain ranges, in which it ascends to a considerable altitude, as shown by the table below, while horizontally its range has been extended over quite a considerable area of southern Nevada.

A study of the present series convinces me that the nearest affinity of the 'tiger rattler' is with the true *Crotalus confluentus* of the plains, in spite of the rather striking and in many respects peculiar aspect of the former.

[The known range of this exceedingly rare rattlesnake has been greatly extended by the expedition, specimens having been secured at frequent intervals from Owens Valley in California to the Great Bend of the Colorado on the boundary between Nevada and Arizona. It was usually found in rocky places in the desert ranges—rarely in the intervening valleys.

When passing through Emigrant Cañon in the Panamint Mountains, in California, April 15, two large rattlesnakes of this species were killed at one shot by Mr. Stephens, at an altitude of 1,400 meters (4,600 feet). They were on a ledge of rock, and were standing erect with their heads near together, apparently playing. In Indian Spring Valley, north of the Charleston Mountains, in Nevada, one was found in a wood-rat's nest that was dug open to secure a large scaly lizard (*Sceloporus magister*) which had taken refuge there. Its stomach contained a kangaroo rat (*Dipodomys*) and a pocket mouse (*Perognathus*), indicating nocturnal habits. Others were killed in the upper part of Vegas Valley (near Cottonwood Springs) and Vegas Wash, Nevada, and in Owens Valley (on Independence Creek), Coso Valley, the Argus Range, Slate Range, Panamint Range, and Grapevine Mountains, California. In the Argus Range nineteen were killed in or near Shepherd Cañon, during the latter part of April and first week of May, by Dr. Fisher's party.—C. H. M.]

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*Proc. Calif. Acad. Nat. Sci., IV, p. 66 (1870).

List of specimens of Crotalus tigris.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18661	ad.	Vegas Valley, Nev		May 1	Merriam	
18662	ad.	Vegas Wash, Nev		May 2	Bailey	
18663	juv.	Indian Spring Valley, Nev		May 29	Merriam	
18664	juv.	Grapevine Mountains, Nev		June 6	Nelson	3,000 feet above Salt Wells.
18665	ad.	Slate Range, Calif	3,100	Apr. 21	Stephens	
18666	ad.	Panamint Mountains, Willow Creek, Calif.	5,500	May 17	Nelson	
18667	juv.	Panamint Mountains, Johnson Cañon, Calif.	5,000	Mar. 30	Fisher	
18668	ad.	Panamint Mountains, Emigrant Cañon, Calif.	4,600	Apr. 16	Stephens	
18669	ad.	do	4,600	do	do	
18670	ad.	Argus Range, Shepherd Cañon, Calif.		Apr. 29	Fisher	
18671	ad.	do		Apr. 27	do	
18672	ad.	Coso Valley, Maturango Springs, Calif.		May 11	Palmer	
18673	ad.	do		do	do	
18674	♀ ad.	Owens Valley, Independence Creek, Calif.	6,500	June 20	Stephens	

Crotalus cerastes Hallow.

The horned rattlesnake has a record somewhat different from that of the foregoing species (*C. tigris*), although inhabiting, in a general way, the same country. It was described much earlier, is less rare in collections, and the geographical range was better known. This difference is probably due to the fact that it is more confined to the desert plains and valleys, while *C. tigris* seems to take its place in the mountains.

The material brought home by the Death Valley Expedition adds considerable detail to our knowledge of the geographical range of the present species, and is, therefore, very valuable and interesting, for the previous material although better than that of *C. tigris*, as intimated above, was scanty and indefinite enough. Thus, if we take the Catalogue of the specimens in the U. S. National Museum (Bull. U. S. Nat. Mus., No. 24, p. 73), we note at once that there is no specimen from the type locality, which is the Mohave Desert and borders of the Mohave River. Dr. Merriam has now supplied this desideratum by the specimen collected April 6, 1891 (No. 18656). We next note that a specimen (No. 8923) was collected by Dr. Yarrow in 'Southern Utah.' The locality is indefinite enough and more than dubious, if for no other reason than the complete absence of any reference to such a specimen in Dr. Yarrow's report upon the reptiles in the fifth volume of Wheeler's Survey West of the One Hundredth Meridian. Another specimen (No. 9116) is said to have been collected by John Kohler in 'Cottonwood Cañon, Nevada.' Turning to the record book we find 'Cottonwood Cañon, Arizona,' and on p. 98 of the catalogue referred to we find that John Kohler collected a *Salvadora grahamiæ* in 'Cottonwood Cañon, Utah.'

The locality is certainly indefinite, to say the least, and a more favorable expression can hardly be used about 'Colorado River, Colorado,' for specimen No. 482, which was probably collected near Fort Yuma, California, and certainly not in the State of Colorado, as the catalogue referred to would seem to indicate.

It is refreshing to turn from these unreliable and confusing statements to the list of exact localities furnished below for each individual specimen taken, and nothing will better illustrate the value of the work done by the Death Valley Expedition than the parallel just drawn.

[The horned rattlesnake or 'sidewinder,' as it is locally known throughout the region it inhabits, is the characteristic snake of the Lower Sonoran deserts of the Great Basin, from southern California easterly across southern Nevada to Arizona and southwestern Utah. It inhabits the open deserts, while its congener of the same region (*C. tigris*) lives in the desert ranges. Its local name is derived from its peculiar mode of progression: when disturbed it moves away sideways, keeping its broadside toward the observer instead of proceeding in the usual serpentine manner. Its bite is said to be fatal, which is probably not the case under ordinary circumstances. A large number were secured by the expedition and many others were killed, but no one was bitten by it. It was found on both sides of Pilot Knob in the Mohave Desert (April 5 and 6) in Pahrump Valley, where four were caught in a space of a mile and half (April 28 and 29); in Vegas Valley (May 1); in Vegas Wash (May 3); in Indian Spring Valley (May 29), where one was shot containing a kangaroo rat (*Dipodomys*) and two pocket mice (*Perognathus*); in the Amargosa Desert (May 31), and in Sarcobatus Flat (June 2). It was common in the valley of the Virgin and Lower Muddy (May 6 and 7), and was said to inhabit Pahranagat Valley, though we did not find it there.

During the latter part of April and the early part of May these rattlesnakes were often found in pairs and were doubtless mating. At such times they remained out in plain sight over night instead of retreating to holes or shelter under desert brush, and on two occasions they were found by us on cold mornings so early that they were too chilled to move until considerably disturbed. I stepped on one of these by accident as it lay in a compact coil with its head in the center, but it was held so firmly by my weight that it was unable to strike. A moment before, I had killed its mate. I killed three on the mesa east of St. Joe, in the valley of the Muddy, in eastern Nevada, May 7.—C. H. M.]

List of specimens of Crotalus cerastes.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18646	ad.	Pahrump Valley, Nev		Apr. 29	Merriam	
18647	ad.	do		do	do	
18648	ad.	do		do	do	
18649	ad.	do		Apr. 28	do	
18650	ad.	Indian Spring Valley, Nev		May 29	Bailey	
18651	ad.	do		do	Merriam	
18652	jun.	Ash Meadows (14 miles north of), Nev		Mar. 11	Stephens	
18653	jun.	Sarcobatus Flat, Nev	4,500	June 2	Bailey	
18654	jun.	Amargosa Desert, Nev		May 31	Merriam	
18655	jun.	Death Valley (Bennett Wells), Calif		Apr. 3	Bailey	
18656	jun.	Mohave Desert, Calif		Apr. 6	Merriam	Type locality.
18657	jun.	Borax Flat (water station), Calif	2,200	Apr. 22	Stephens	
18658	ad.	Panamint Valley, Calif		Apr. 24	Nelson	
18659	ad.	do		Apr. 23	Bailey	
18660	ad.	Lone Pine, Calif		June 7	Palmer	

Crotalus lucifer B. & G.

The questions whether there is more than one separable form of this species within the Pacific region and, in case of an affirmative answer, what names are to be employed for the various forms, are yet open, awaiting the accumulation of much additional material. It may even be found that the name adopted above for the species is not the oldest tenable; but, not being able to settle that point at present, I retain *C. lucifer* as undoubted in its application. On the other hand, that it is a good and distinct species, well separated from *C. confluentus*, and not a subspecies of the latter, I feel perfectly confident.

The present species is characteristic of the interior valley and slopes of California as contrasted with the Great Basin, and the boundary between the two forms seems to be quite sharply drawn, at least in the regions visited by the expedition. There is probably no stronger contrast among the reptiles of the same genus met with by the Death Valley explorers than that between the pale and clay colored rattlesnakes in the desert plains and mountains and the dark colored *C. lucifer* which they obtained only in the San Joaquin Valley and in the mountain slopes encircling it.

[This species does not inhabit the Great Basin, but was found in a number of localities on the west or coastal slope of the Sierra, and in the San Joaquin Valley. Specimens were obtained at Old Fort Tejon, in the Cañada de las Uvas, and thence northward on the west slope of the mountains to Tehachapi Pass, Kern Valley, Kaweah River, Kings River Cañon, the San Joaquin River, and the Merced River (on the latter as high as 2,620 meters or 8,600 feet).—C. H. M.]

List of specimens of Crotalus lucifer.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18675	ad.	Old Fort Tejon, Calif		July 7	Palmer	
18676	adol.	Bakersfield, Calif		July 17	Bailey	
18677	ad.	Kernville, Calif	2,400	July 10	do	
18678	jun.	Soda Springs, North Fork Kern River, Calif		Aug. 12	do	
18679	♂	East Fork Kaweah River, Calif	4,500	July 28	do	Skin.
18680	ad.	King's River Cañon, Calif		Aug. 14	Palmer	
18681	ad.	North Fork San Joaquin River, Calif.	6,600	July 29	Nelson	
18682	ad.	Merced River, Calif	8,000	Aug. 4	do	
18683	ad.	do	8,600	do	do	

B.—BATRACHIA.

Order ANURA.

Family BUFONIDÆ.

Bufo punctatus B. & G.

This species of rather wide distribution belongs to the Lower Sonoran fauna, and is not known from the interior valley of California. It probably finds its northern limit not far from where the numerous specimens of the expedition were collected.

List of specimens of Bufo punctatus.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18748	ad.	Death Valley, Calif		Mar. 22	Nelson	
18749	ad.	do		do	do	
18750	ad.	do		do	do	
18751	ad.	do		do	do	
18752	ad.	do		do	do	
18753	ad.	do		do	do	
18754	ad.	do		do	do	
18755	ad.	do		do	do	
18756	ad.	Death Valley, Furnace Creek, Calif.		Mar. 21	do	
18757	ad.	do		do	do	
18758	ad.	do		do	do	
18759	ad.	do		do	do	
18760	ad.	do		do	do	
18761	ad.	do		do	do	
18762	ad.	do		do	do	
18763	ad.	do		do	do	
18764	ad	do		do	do	
18765	ad.	do		do	do	
18766	ad.	do		do	do	
18767	ad.	do		do	do	
18768	ad.	do		do	do	
18769	ad.	do		do	do	
18770	ad	do		do	do	
18771	ad	do		do	do	
18772	ad.	do		do	do	
18773	ad.	do		do	do	
18774	ad	do		do	do	
18775	ad.	do		do	do	
18776	ad.	do		do	do	
18777	ad.	do		do	do	
18778	ad.	do		do	do	
18779	ad.	do		do	do	
18780	ad.	do		do	do	
18781	ad.	do		do	do	
18782	ad.	d ,		Apr. 10	Stephens	
18783	larvæ.	do		Feb. 4	Fisher	
18784	ad.	Panamint Mountains, Cottonwood Cañon, Calif.	2,700	May 29	Nelson	
18785	adol.	*do*		do	do	

Bufo halophilus B. & G. (Plate III, figs. 3 *a–b*).

Of rather general distribution, as specimens were collected by the expedition inside the great interior valley of California, on the Pacific coast near Monterey, and in various localities in Owens Valley, east of the Sierra Nevada. Its vertical range is hardly less extended, having been found from the level of the sea to more than 10,000 feet above.

List of specimens of Bufo halophilus.

U. S. Nat. Mus. No.	Sex and Age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18719	adol.	Owens Valley, Alvord, Calif.	4,000	June 26	Stephens.	
18720	juv.	Owens Valley, Bishop Creek, Calif.	4,000	June 29	....do	
18721	juv.	......do	4,000	June 29	....do	
18722	juv.	......do	4,000	June 29	....do	
18723	ad.	Owens Valley, Independence Creek, Calif.	6,000	June 19	....do	
18724	jun.	......do	6,000	June 19	....do	
18725	ad.	Owens Valley, Lone Pine, Calif.	....	June 18	Nelson.	
18726	ad.	......do	....	June 7	Palmer.	Pl. III. fig. 3 *a-b*.
18727	adol.	......do	....	June 6	....do	
18728	jun.	......do	....	June 6	....do	
18729	adol.	Round Valley, Tulare County, Calif.	10,000	Aug. 22	....do	
18730	adol.	Whitney Meadows, Calif.		Aug. 20	Bailey.	
18731	adol.	Kings River, Calif.	5,200	Aug. 19	Nelson.	
18732	adol.	Elizabeth Lake, Calif.	....	July 2	Palmer.	
18733	jun.	Monterey, Calif.	About sea level.	Sept. 30	Bailey.	
18734	jun.	......do	..do	Oct. 1	....do	
18735	tadpoles	East Fork, Kaweah River, Calif.	10,200	Aug. 7	....do	
18736	do	......do	10,200	Aug. 7	....do	
18737	do	......do	10,200	Aug. 7	....do	

Bufo boreas nelsoni, subsp. nov. (Pl. III, figs. 4 *a–b*).

Diagnosis.—Similar to *B. boreas:* Skin between warts smooth; snout protracted, pointed in profile; webs of hind legs very large; soles rather smooth; limbs shorter, elbows and knees not meeting when adpressed to the sides of the body; inner metacarpal tubercle usually very large.

Habitat.—Southeastern California and western Nevada.

Type.—U. S. Nat. Mus., No. 18742; Oasis Valley, Nevada, March 16, 1891; F. Stephens, coll.

This seems to be the southern form of *Bufo boreas*, distinguished from the latter as above. Extreme examples of both forms are very different and would readily pass for distinct species, but specimens occur in which one or the other of the characters are less developed, making it expedient to use a trinominal appellation.

On the other hand, both *B. boreas* and the new form here described are quite well separated from *B. halophilus* and its northern race, *B. halophilus columbiensis*, the difference in profile of the snout being quite sufficient (comp. pl. III, figs. 3*a* and 4*a*), not to mention the other characters indicated in the diagnosis above. Their geographical distribution, as examplified by the material brought home by the Death Valley Expedition, furnishes sufficient proof of the specific value of their differences, for while we find *B. halophilus* alone in the valley of California, both species were collected in the same localities east of the Sierra Nevada.

The name of this form is selected in honor of Mr. E. W. Nelson for his valuable zoögeographical work both in the extreme south and in the extreme north of our country.

List of specimens of Bufo boreas nelsoni.

U.S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18738	ad.	Oasis Valley, Nev.		Mar. 16	Stephens	
18739	ad.	do		do	do	
18740	ad.	do		do	do	
18741	ad.	do		do	do	
18742	ad.	do		do	do	Type.
18743	ad.	do		do	Nelson	
18744	adol.	Resting Springs, Calif		Feb. 7	Fisher	
18745	jun.	do		do	do	
18746	ad.	Owens Valley, Morans, Calif	5,000	July 4	Stephens	
18747	ad.	Owens Valley, Lone Pine, Calif		June 18	Nelson	

Bufo lentiginosus woodhousii (Gir.).

The three specimens mentioned below are rather young, and are referred to under the above name more because they occur in the region commonly assigned to this form than because they conform to the characters ascribed to it. As a matter of fact, I have yet to discover a character, or a combination of characters of *sufficient* stability to enable me to distinguish *B. woodhousii* from *B. americanus*. Proportions, parallelism or divergence of cranial ridges, and single or double subarticular tubercles on the toes, seem all entirely valueless as characters.

[Specimens of this toad were collected in Pahranagat and Vegas valleys, Nevada; and toads, probably the same species, were common in the Lower Muddy and Virgin valleys, Nevada, and at the mouth of Beverdam Creek, Arizona.—C. H. M.]

List of specimens of Bufo lentiginosus woodhousii.

U.S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18716	jun.	Pahranagat Valley, Nev		May 25	Bailey	
18717	jun.	Vegas Valley, Nev		Mar. 13	Nelson	
18718	jun.	do		Mar. 14	Bailey	

Family SCAPHIOPODIDÆ.

Scaphiopus hammondii Baird.

The four specimens representing various sizes and ages from the same locality will ultimately be of great help in better understanding the status of this species. The few specimens now in the collections from a number of localities scattered over a very wide area, and often in a bad state of preservation, form a very unsatisfactory material upon which to base a rational discussion of the question.

List of specimens of Scaphiopus hammondii

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18786	ad.	Owens Lake, Olancha, Calif	3,700	May 21	Stephens	
18787	adol.	do		May 18	do	
18788	adol.	do	3,700	May 25	do	
18789	juv.	do		May 18	do	

Family HYLIDÆ.

Hyla regilla B. & G.

We have been so accustomed to regard this species as chiefly 'Pacific' in its distribution that it was rather a surprise to receive such an enormous number of specimens from so many localities in the desert regions visited by the expedition. Our knowledge as to the geographical distribution of this species has consequently been considerably extended, and there can be no doubt that the material gathered will be of extreme importance whenever it shall be possible to work up in detail the unequaled series in the National Museum. As my assistant, Mr. Frederick C. Test, has been engaged for some time upon this work, I shall refrain from further remarks in order not to forestall any of his conclusions.

[On the west or coastal slope of the Great Divide in California, tree toads of this species were found in Kern Valley, Walker Basin, and at Old Fort Tejon in the Cañada de las Uvas. On the east or Great Basin side of the divide they were tolerably common about the spring in Surprise Cañon in the Panamint Mountains, at Hot Springs in Panamint Valley, at Saratoga Spring at the south end of Death Valley, and at Resting Springs. In Nevada they were found in Ash Meadows, Oasis, Pahrump, and Vegas valleys.—C. H. M.]

List of specimens of Hyla regilla.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18790	ad.	Panamint Mountains, Johnson Cañon Calif.	*6,000	Mar. 31	Fisher	
18791	ad.	do	6,000	do	do	
18792	ad.	do	6,000	do	do	
18793	ad.	do	6,000	do	do	
18794	ad.	do	6,000	do	do	
18795	ad.	do	6,000	do	do	
18796	ad.	do	6,000	do	do	
18797	ad.	do	6,000	do	do	
18798	ad.	do	6,000	do	do	
18799	ad.	do	6,000	do	do	
18800	ad.	do	6,000	do	do	
18801	ad.	do	6,000	do	do	
18802	ad.	do	6,000	do	do	
18803	ad.	do	6,000	do	do	
18804	ad.	do	6,000	do	do	
18805	ad.	do	6,000	do	do	
18806	ad.	do	6,000	do	do	
18807	ad.	do	6,000	do	do	
18808	ad.	do	6,000	do	do	
18809	ad.	do	6,000	do	do	
18810	ad.	do	6,000	do	do	
18811	ad.	do	6,000	do	do	
18812	ad.	do	6,000	do	do	
18813	ad.	do	6,000	do	do	
18814	ad.	do	6,000	do	do	
18815	ad.	do	6,000	do	do	
18816	ad.	do	6,000	do	do	
18817	ad.	do	6,000	do	do	
18818	ad.	do	6,000	do	do	
18819	ad.	do	6,000	do	do	
18820	ad.	do	6,000	do	do	
18821	ad.	do	6,000	do	do	
18822	ad.	do	6,000	do	do	
18823	ad.	do	6,000	do	do	
18824	ad.	Panamint Mountains, Surprise Cañon, Calif.		Apr. 23	do	
18825	ad.	do		do	do	
18826	ad.	do		do	do	
18827	ad.	do		do	do	
18828	ad.	do	2,600	Apr. 21	Bailey	
18829	ad.	do	2,600	do	do	
18830	juv.	Whitney Creek, Calif		Aug. 18	do	
18831	ad.	Whitney Meadows, Calif		Sept. 1	Fisher	
18832	adol.	do		Aug. 20	Bailey	
18833	juv.	do		Aug. 29	do	
18834	juv.	do		do	do	
18835	juv.	do		do	do	
18836	juv.	do		do	do	
18837	ad.	Near Whitney Meadows, Calif		Aug. 23	do	Among granite rocks.
18838	ad.	Panamint Mountains, Calif		Apr. 22	Nelson	
18839	ad.	do		do	do	
18840	ad.	Panamint Valley, Hot Springs, Calif.		do	Fisher	
18841	ad.	do		do	do	
18842	juv.	do		do	do	
18843	juv.	do		do	do	
18844	juv.	do		do	do	
18845	juv.	do		do	do	
18846	ad.	Resting Springs, Calif		Feb. 8	Palmer	
18847	ad.	do		Feb. 7	Fisher	
18848	ad.	do		do	do	
18849	ad.	do		Feb. 17	do	
18850	ad.	do		do	do	
18851	ad.	do		do	do	
18852	ad.	do		do	do	
18853	adol.	Saratoga Springs, Calif		Jan. 30	Bailey	In pond at spring.
18854	adol.	do		do	do	
18855	adol.	do		do	do	
18856	ad.	Hot Springs, Calif		Jan. 9	do	
18857	♂ ad.	South Fork Kern River, 25 miles above Kernville, Calif.		July 4	Fisher	
18858	juv.	Kern River, Calif		do	do	

*About.

List of specimens of Hyla regilla—Continued.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Alti-tude.	Date.	Collector.	Remarks.
			Feet.			
18859	ad.	Walker Basin, Calif		July 15	Fisher	
18860	juv.	Antelope Valley, near La Liebre Rancho, Calif.		June 27	Palmer	
18861	ad.	Old Fort Tejon, Calif		July 3	do	
18862	ad.	do		July 6	do	
18863	ad.	do		do	do	
18864	ad.	do		July 11	do	
18865	ad.	South Fork Merced River, Calif	8,900	July 31	Nelson	
18866	ad.	Horse Corral Meadows, Calif	8,000	Aug. 12	Palmer	
18867	ad.	Kings River, Calif	7,500	Aug. 19	Nelson	
18868	juv.	Cottonwood Meadows, Calif		Aug. 24	Dutcher	
18869	juv.	do		do	do	
18870	juv.	do		do	do	
18871	ad.	Monterey Calif		Oct. 2	Bailey	In vine on an arbor.
18872	juv.	do		Sept. 29	do	
18873	juv.	do		Sept. 30	do	
18874	juv.	do		do	do	
18875	ad.	Charleston Mountains, in Mountain Spring, Nev.	5,600	Apr. 30	do	
18876	ad.	do	5,600	do	do	
18877	ad.	do	5,600	do	do	
18878	ad.	do	5,600	do	do	
18879	ad.	do	5,600	do	do	
18880	ad.	Pahrump Valley, Nev		Feb. 21	Nelson	
18881	ad.	Pahrump Valley, Yount's Ranch, Nev.		Apr. 28	Bailey	
18882	ad.	do		do	do	
18883	juv.	do		do	do	
18884	juv.	do		do	do	
18885	ad.	Mountain Spring, Charleston Mountains, Nev.		Mar. 6	do	
18886	ad.	do		do	do	
18887	ad.	Corn Creek, Vegas Valley, Nev		Mar. 15	do	
18888	ad.	do		do	do	
18889	ad.	Vegas Valley, Nev		Mar. 13	do	
18890	ad.	do	1,800	Mar. 14	do	In spring.
18891	ad.	do		Mar. 13	Nelson	
18892	ad.	do		do	do	
18893	ad.	do		do	do	
18894	ad.	do		do	do	
18895	ad.	do		do	do	
18896	ad.	do		do	do	
18897	juv.	do		do	do	
18898	juv.	do		do	do	
18899	juv.	do		do	do	
18900	adol.	Vegas Valley, Cottonwood Spring, Nev.		Apr. 30	Bailey	
18901	adol.	do		do	do	
18902	ad.	Oasis Valley, Nev		Mar. 16	Stephens	
18903	ad.	do		do	do	
18904	ad.	do		do	do	
18905	ad.	do		do	do	
18906	ad.	do		do	do	
18907	ad.	do		do	do	
18908	ad.	do		do	do	
18909	ad.	do		do	do	
18910	ad.	do		do	do	
18911	ad.	do		do	do	
18912	ad.	do		do	do	
18913	ad.	Ash Meadows, Nev		Mar. 20	Fisher	
18914	ad.	do		do	do	
18915	ad.	do		do	do	
18916	ad.	do		do	do	
18917	ad.	do		do	do	
18918	ad.	do		Mar. 13	do	
18919	ad.	do		do	do	
18920	ad.	do		do	do	
18921	ad.	do		Mar. 18	Palmer	
18922	juv.	do		Mar. 4	do	
18923	juv.	do		Mar. 2	Bailey	
18924	ad.	do		Mar. 4	Stephens	
18925	ad.	do		Mar. 17	Nelson	
18926	ad.	do		Feb. 28	do	

Family RANIDÆ.

Rana draytonii B. & G.

Of this well-marked species, Mr. Bailey collected two adults and two young ones at Monterey, the latter in a spring near the beach. The specimens are in fine condition, and display the distinctive characters very well. The vicissitudes of this species demonstrate beautifully the disastrous results of prejudiced desires of 'lumping' species.

List of specimens of Rana draytonii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	ad.	Monterey, Calif	Near sea level.	Oct. 3	Bailey	In spring, near beach.
[illegible]	ad.	do	do	do	do	Do.
[illegible]	juv.	do	do	Sept. 30	do	
[illegible]	juv.	do	do	do	do	

Rana aurora B. & G.

The specimens referred to this species agree in such essential points with the types of *R. aurora*, that I have been obliged to so name them, the only other alternative being to describe them as new. It is my conviction that the result of a careful study of a large number of specimens from the Pacific province will result in the establishment of several more species or subspecies than at present recognized, but I also feel that the final settlement must be deferred until a more propitious time for a monographic essay on the various forms which cluster around *R. aurora*, *pretiosa*, and *draytonii*. Under these circumstances I deem it inadvisable to establish any new names, the more so since I hope it will not be long before I shall be able to devote the necessary time to this question.

It is hardly necessary to add that it is out of the question to base any generalizations upon the supposed geographical distribution of these forms as they are defined for the present.

The character which associates the present specimens so strongly with *R. aurora* is the smoothness of the skin, although very minutely pitted, and the very strong pitting of the line which takes the place of the dorso lateral fold in the other species. The differences consist chiefly in shorter snout, fuller webbing of the toes, broader tongue, and darker color.

List of specimens of Rana aurora.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	ad.	Sequoia National Park, Calif	7,000	Aug. 2	Palmer	
[illegible]	ad	do	7,000	Aug. 6	do	Halsted Meadows.
[illegible]	ad.	do	7,000	do	Fisher	Do.

Rana pretiosa B. & G.

The remarks under *R. aurora* refer as well to the present species. The southern specimens which have come under my notice have the white (or yellow) supralabial stripe ill-défined and more or less interrupted, especially behind the angle of the mouth; while in the northern specimens this stripe usually is well-defined and uninterrupted.

List of specimens of Rana pretiosa.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18928	ad.	Sierra Nevada, Calif	8,400	July 24	Stephens	
18929	ad.	Mulkey Meadows, Sierra Nevada, Calif.	9,000	...do	...do	
18930	ad.	...do	9,000	...do	...do	
18931	ad.	Chiquito, San Joaquin River, Calif	9,800	July 31	Nelson	Head of river east of Mt. Raymond.
18932	ad.	...do	9,800	...do	...do	Do.
18933	adol.	Head of Big Cottonwood Creek, Calif	11,000	Sept. 11	Dutcher	Near Mount Whitney.
18934	adol.	...do	11,000	Sept. 13	...do	
18935	adol.	...do	11,000	...do	...do	
18936	adol.	...do	11,000	...do	...do	
18937	adol.	...do	11,000	...do	...do	
18938	juv.	...do	11,000	...do	...do	
18939	ad.	Whitney Creek, Calif		Aug. 18	Bailey	
18940	ad.	East Fork Kaweah River, Calif	10,200	Aug. 7	...do	In little lake.
18941	ad.	...do	10,200	...do	...do	Do.
18942	adol.	...do	10,200	...do	...do	Do.
18943	juv.	...do	10,200	...do	...do	Do.
18944	adol.	Mineral King, Calif	7,500	July 31	...do	
18945	adol.	Lone Pine, Calif		Aug. 21	Fisher	
18946	ad.	South Fork Merced River, Calif	8,800	July 31	Nelson	

Rana boylii Baird.

In a recent paper* (December, 1891) Boulenger expresses the opinion that *R. boylii* is only a synonym of *R. draytonii*. It is evident that he has arrived at this conclusion without having had opportunity to compare authentic specimens of both species, for otherwise it would be impossible to make such a mistake. The two species differ in all essential points, and among the many puzzling Western forms of this genus none are more easily separated. Dentition, tympanum, and dorsolateral glands are so different that once seen the two species can not well be confounded. *R. boylii* has the tympanum almost concealed and covered with tubercles, the vomerine teeth in an oblique longitudinal series on each side, and the dorso-lateral fold flattened out so as to be nearly, or entirely, imperceptible, while *R. draytonii* has a smooth, distinct tympanum, vomerine teeth in clusters, and very prominent dorso-lateral folds.

The specimens which I have referred to *R. boylii* differ from the type of the latter in a few minor points, chief of which is the narrowness of the tongue; but as the specimens are rather small, much stress ought not to be attached to this point. Moreover, I would again refer to my

*Ann. Mag. Nat. Hist. (6), VIII, p. 453.

remarks under *R. aurora* as to the inadvisability of meddling with the status of the Californian frogs in the present connection.

List of specimens of Rana boylii.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
[illegible]	ad.	South Fork Kern River, Calif.	....	July 4	Fisher	25 miles above Kernville.
18951	ad.	Kernville, Calif.	....	June 23	Palmer	
18952	ad.	......do	....	....do	....do	

Rana fisheri, sp. nov. (Plate III, figs. 5*a–c*.)

Diagnosis.—Heel of extended hind limb reaching anterior eye canthus, falling considerably short of tip of snout; vomerine teeth between and projecting posteriorly beyond choanæ; no black ear patch; vertical diameter of tympanic disc greater than distance between nostrils and eye; hind feet webbed for about two-thirds; one small metatarsal tubercle; one weak dorso-lateral dermal fold, no dorsal folds between; posterior lower aspect of femur granular; back and sides with numerous small, distinct, dark spots, surrounded by lighter; no external vocal sacs.

Habitat.—Vegas Valley, Nevada.

Type.—U. S. Nat. Mus., No. 18957; Vegas Valley, Nevada, March 13, 1891; V. Bailey coll.

Not closely allied to any of the known species. The coloration is very distinct, resembling somewhat that of *R. aesopus;* the great size of the tympanic disc is also quite characteristic, being larger than in any of our species, except *R. catesbiana*, *clamitans*, and *septentrionalis.*

I should have considered it rather risky to describe a new species of *Rana* from the West had it not been for the fact that the great number of the specimens collected established beyond a doubt the constancy of the characters mentioned.

This species is dedicated to Dr. A. K. Fisher in recognition of his share in the herpetological success of the Death Valley Expedition.

[Frogs were tolerably common in Beaverdam Creek near its junction with the Virgin in northwestern Arizona, May 8, but whether *Rana fisheri* or *R. pipiens brachycephala* is not certain. The former was collected in Vegas Valley (type locality); the latter in Pahranagat Valley.—C. H. M.]

List of specimens of Rana fisheri.

U. S. Nat. Mus. No.	Sex and age.	Locality.	Altitude.	Date.	Collector.	Remarks.
			Feet.			
18957	ad.	Vegas Valley, Nev.		Mar. 13	Bailey	Type.
18958	ad.	do		Mar. 9	do	
18959	ad.	do		Mar. 13	do	
18960	ad.	Las Vegas Ranch, Vegas Valley, Nev.		Mar. 9	Nelson	
18961	ad.	do		do	do	
18962	ad.	do		do	do	
18963	ad.	do		do	do	
18964	ad.	do		do	do	
18965	ad.	do		do	do	
18966	ad.	do		do	do	

Rana pipiens brachycephala (Cope).

The western form of the green frog evidently reaches its western limit in Nevada, and from the fact that the expedition only brought home one specimen it may probably be concluded that it is rare in that region. This specimen was collected in Pahranagat Valley, Nevada, May 25, 1891, by Vernon Bailey (No. 18927).

As to the name *Rana pipiens* Schreber, adopted in preference to *R. virescens* 'Kalm,' I may remark that as the latter was never used by Kalm in a binominal sense, it being only the first word of his diagnosis of the species, the former is beyond doubt the oldest tenable name for the species. From some of the recent synonymies it might be inferred that *Rana virginiana* of Laurenti (1768) would be the name, but I need only quote his diagnosis, viz, "corpore cinereo, dorso quinqueangulato quinquestriato; maculis rubris; abdomine, pedibusque flavescentibus," to show that it can never be identified as our shad-frog.

This question has already been settled by Prof. S. Garman in 1888 (Bull. Ess. Inst., xx, pp. 90, 100), and I am only induced to repeat and corroborate it here, as one might be led to believe, from Cope's treatment of the matter (Man. N. Am. Batr., 1889, p. 399), that Garman is responsible for the adoption of *Rana virescens.*

REPORT ON THE FISHES OF THE DEATH VALLEY EXPEDITION COLLECTED IN SOUTHERN CALIFORNIA AND NEVADA IN 1891, WITH DESCRIPTIONS OF NEW SPECIES.

By Charles H. Gilbert, Ph. D.

LIST OF SPECIES.

Ameiurus nebulosus Le Sueur.
Catostomus arœopus Jordan.
Rhinichthys (Apocope) velifer, sp. nov.
Rhinichthys (Apocope) nevadensis, sp. nov.
Rutilus symmetricus (B. & G.).
Lepidomeda vittata Cope.
Cyprinus carpio Linn.
Salmo irideus Gibbons.
Salmo mykiss agua-bonita Jordan.
Cyprinodon macularius Girard.
Cyprinodon macularius baileyi, subsp. nov.
Empetrichthys merriami, gen. et sp. nov.
Gasterosteus williamsoni Girard.

Ameiurus nebulosus Le Sueur.

Two specimens of this introduced species were procured at Lone Pine, on Owens River, where the species was reported as abundant.

Catostomus aræopus Jordan.

Type locality.—South Fork of Kern River, California.

One specimen from Reese River, Nevada. Collected by Vernon Bailey.

Rhinichthys (Apocope) velifer, sp. nov. (Plate VI, Fig. 2.)

Type locality.—Pahranagat Valley, Nevada.

This species is closely related to *Rhinichthys yarrowi*, from which it differs in the much larger scales, the lateral line traversing 55 instead of 74 to 83 scales. Both species mark such perfect transition between *Apocope* and *Rhinichthys* that it seems best to reduce the former to the rank of a subgenus. About half the specimens of *yarrowi* have a narrow frenum, and this is present in each of the three type specimens of *velifer*. In both *yarrowi* and *velifer* the teeth are 2–4–4–2, as in typical *Rhinichthys*. The only character left to distinguish *Apocope* is the narrowness of the frenum when present, it being very wide in typical *Rhinichthys*.

Head 4 in length; depth, $4\frac{3}{5}$. Snout narrow, but bluntly rounded, not projecting beyond the front of premaxillaries. Frenum joining premaxillaries to skin of forehead very narrow, varying in width in the three type specimens. It will probably be found that some specimens of this species, as of *yarrowi*, have protractile premaxillaries. Mouth small, horizontal, the maxillary reaching vertical from front of orbit, equaling diameter of eye, 3½ in length of head. Interorbital width, 3 in head.

Teeth 2, 4–4, 2, hooked, with sharp edges.

Pectorals nearly reaching base of ventrals, the latter long, overlapping front of anal fin. Origin of dorsal fin midway between base of caudal and middle of eye.

D., 8; A., 7 Lat. l. 56 (pores). 10 scales in a series obliquely forward to lateral line from base of first dorsal ray.

Color in spirits, brown along back, a black band from snout across cheeks and along middle of sides, with a narrow silvery streak above it. Lower half of sides and belly silvery; an ill-defined dark streak from base of pectorals back along sides to the end of the anal fin. A small black spot on base of caudal.

Three specimens were taken in a hot spring in Pahranagat Valley, Nevada, May 25, 1891, by C. Hart Merriam and Vernon Bailey. Temperature of spring 36.11° C. (97° F.).

Rhinichthys (Apocope) nevadensis, sp. nov. (Plate VI, Fig. 1.)

Type locality.—Ash Meadows, Amargosa Desert, on boundary between California and Nevada.

Differing from other known species in the large head, the short deep body, very small eye, and in the reduction of the outer ventral ray to a mere rudiment.

Head, 3⅗ in length (varying from 3⅓ to 4); depth, 3⅗ (varying from 3⅓ to 4). D., 8; A., 7. Lat. l. 65. Ventrals apparently with seven rays, the outer one rudimentary, and often to be detected with difficulty.

Body robust, with broad heavy head, the least depth of caudal peduncle less than half the greatest height of body. Greatest depth of head at occiput 5 in length of body (6¼ in nubila of equal size). Eye very small, half interorbital width, which equals distance from tip of snout to middle of eye, and is contained 2⅗ times in head.

Mouth terminal, very oblique, the lower jaw included, the premaxillaries not at all overlapped by the snout. The maxillary reaches the vertical from front of eye, and is one-third length of head. Maxillary barble well developed.

Scales very irregularly placed, and difficult to enumerate. The lateral line is incomplete in adults, and usually does not reach to opposite dorsal fin. In the young it is variously developed, often extending, though with many interruptions, to end of dorsal or base of caudal. Pores in lateral line (when complete) 58, about 66 oblique series, counted above lateral line.

Fins small, the pectorals not reaching ventrals, the latter not to vent. Front of dorsal midway between base of caudal and middle of occiput.

In spirits, the upper half of sides is speckled and marbled with brown; the belly and lower half of sides immaculate or sparsely spotted. A broad dark lateral stripe usually present, becoming more conspicuous posteriorly, and ending in an obscure black spot on base of tail. A dark stripe sometimes present along middle of lower half of sides.

Numerous specimens were procured in the warm springs at Ash Meadows, Indian Creek, and Vegas Creek, Nevada.

Rutilus symmetricus (Baird and Girard).

Type locality.—Old Fort Miller, Fresno Co., San Joaquin Valley, California.

Specimens from Owens Lake, California, seem to agree with those reported on by Jordan and Henshaw (*Leucos formosus*, Rep. Chief Engineer, Wheeler Surv. W. 100th Mer., App. NN, 1878, 193) from Washoe Lake, Nevada, and Kern Lake, California. There are 11 scales between lateral line and front of dorsal, and 52 scales in lateral line. Teeth 4–5. There are seven or eight rays in the anal fin, and the head is $3\frac{3}{5}$ in the length. The lateral line is imperfect in the young.

The American species of this genus are poorly defined, and may be reducible to one or two species. If the specific forms prove to be numerous there is no assurance that these specimens are identical with the types of *Pogonichthys symmetricus* and *Algansea formosus* from the San Joaquin and Mohave rivers.

Lepidomeda vittata Cope.

Type locality.—Little Colorado River, Arizona.

Three small specimens from Pahranagat Valley, Nevada, agree well with the original description of this species, and are probably referable to it. It has been recorded hitherto only from the original locality, the Colorado Chiquito River, Arizona, and its occurrence in the present locality is full of interest. Not only *Lepidomeda* but the whole subfamily (the *Plagopterinæ*) to which it belongs, is peculiar to the basin of the Colorado River, to which the Pahranagat waters must belong.

Cyprinus carpio Linn.

A specimen of this introduced species was found dead on the shores of Owens Lake. Carp and catfish are both common in the lower Owens River, and when they enter the lake are soon killed by the alkalinity of the water.

Mr. Palmer and Dr. Fisher reported carp as the staple food fish at Three Rivers on the Kaweah River, where numerous large individuals were taken.

Salmo irideus Gibbons.

Type locality.—San Leandro Creek, Alameda Co., California.

A single specimen of the 'Rainbow Trout' was preserved by Dr. A. K. Fisher from the Cañon of Kings River. Compared with specimens from the Santa Cruz Mountains in the vicinity of Palo Alto, this is found to agree in all respects. The coloration is very bright as is usual in the colder mountain streams. The scales above the lateral line are arranged in 135 oblique series.

Salmo mykiss agua-bonita Jordan.

Type locality.—Whitney Creek south of Mt. Whitney, High Sierra, California. (Jordan, Report State Fish Commissioners of California, 1892, p. 62.)

Several specimens of this, the 'Golden Trout' of Kern River, were collected in Whitney Creek, whence came the original types, and from Cottonwood Creek, a tributary of Owens Lake, to which they have been transplanted. Two specimens were also preserved, taken from the South Fork of Kern River. They agree perfectly with the original description cited. The scale formula should read 180 to 200, not 130 to 200, as in the original description.

Cyprinodon macularius Girard.

Type locality.—Rio San Pedro, Arizona.

(*Cyprinodon nevadensis* Eigenmann, Proc. Cal'a Acad. Nat. Sci., 1889, 270.)

This small Cyprinodont inhabits the springs and wells throughout the desert region of southern California, Arizona and Nevada, and is the characteristic denizen of the more or less alkaline waters of this district. The original types are from the Rio San Pedro, a tributary of the Rio Gila, and I have found it abundant at a pond at Lerdo, Mexico, on the lower Colorado River. Specimens obtained at Lerdo have been compared with those from Death Valley and found identical.

The species varies in form and color, and apparently in the size which it reaches in different localities. The males have the back and sides uniform dusky, the lower parts lighter, all the fins in the most brightly colored individuals being broadly margined with black. The females have the lower half of sides as well as belly lighter, often silvery white, the sides crossed by black bars, which are wide along middle of body, but become much narrower than the interspaces on the lower half of sides. The bars vary in number and size and often alternate with narrower, fainter, and shorter ones. The fins are light, and the dorsal either with or without a black blotch on its posterior rays. Although usually uniform in coloration, the males occasionally show lateral bars, which, however, contrast little with the general dusky color of the sides.

The dorsal varies from 9 to 11, and the anal from 10 to 11. There are 24 or 25 transverse series of scales, and the humeral scale is but little enlarged. The head is contained 3 to $3\frac{1}{4}$ times in the length. Adults are very short and deep, the depth being nearly or quite half the length; in half-grown specimens 1 inch long, the depth is contained $2\frac{2}{5}$ in the length. The eye is very small, about equaling the snout, contained $1\frac{1}{2}$ to $1\frac{2}{3}$ times in the interorbital width, and $3\frac{2}{3}$ times in the head. The front of dorsal is usually midway between occiput and base of caudal.

The normal number of ventral rays in this species seems to be six. No specimen examined has shown more than this number, and in several but five are present. In one specimen from Ash Meadows, Nevada, the ventral of one side only is present, and contains but three or four rays. Four young specimens from the same locality and two from Medbury Springs, Amargosa Desert, California, have the ventrals wholly aborted, and show on dissection no trace of the basals. These occur in the same lots with other specimens having normal ventrals, and are otherwise indistinguishable from them. No full-grown adults were found without ventrals, the largest being a half-grown specimen about one inch long with the characteristic coloration of the males already developed. Ten young specimens from the 'Devil's Hole,' Ash Meadows, are all without ventrals, and further collections from this locality would be of interest.

In the intestines were found fragments of insects, and in one series of specimens from Saratoga Springs at the south end of Death Valley, California, very numerous shells of a small Gasteropod mollusk.

Specimens are in the collection from the following localities: Medbury Spring (6 miles north of the Borax Works), Amargosa Desert, California; Ash Meadows, Amargosa Desert, Nevada; Saratoga Springs, Death Valley, California; Amargosa Creek, California.

Cyprinodon macularius baileyi, subsp. nov.

Type locality.—Pahranagat Valley, Nevada, collected by C. Hart Merriam and Vernon Bailey, May 25, 1891.

Eleven immature specimens from Pahranagat Valley, Nevada, show no trace of ventral fins. They are olivaceous above, bright silvery on the lower half of sides and below, and have two lengthwise series of coarse black spots, one along middle line of body, the other on a level with the lower edge of caudal peduncle. The anal fin is larger than in typical *macularius*, the eleven specimens having each 13 rays instead of 10 or 11, as constantly in the latter. The material is insufficient to fully decide the status of this form. Except in the characters noted it agrees in proportions and formulæ with *macularius*.

EMPETRICHTHYS gen. nov. (Plate V.)

(Cyprinodontidæ).

Intestines short, $1\frac{1}{2}$ times length of body. Teeth conic, fixed, in each jaw arranged in a band consisting of two or three rows, the outer series somewhat enlarged. Ventrals absent. Branchiostegals five. Both upper and lower pharyngeals greatly enlarged and bearing molar teeth, tubercular in shape. The lower pharyngeals are firmly attached to the ceratobranchials of the fourth arch, while the massive epibranchials of the same arch serve to connect them firmly at the sides with the pharyngobranchials above. The fourth branchial arch bears normal gills. Its median portion is produced anteriorly, forming a triangular extension of the lower pharyngeals in the middle line. On the oral surface this is indistinguishable from the pharyngeals proper, and like them bears molar teeth.

Scales normal, large, regularly imbricated, nowhere tubercular or ridged.

This genus seems most nearly allied to *Orestias*, of which numerous species have been described from lakes in the high Andes of South America.

Empetrichthys merriami, sp. nov. (Plate v.)

Type locality.—Ash Meadows, Amargosa Desert, on boundary between California and Nevada.

In form and general appearance much resembling the mud minnow (*Umbra limi*), though somewhat deeper and more compressed.

Head compressed, its upper surface slightly convex. Mouth very oblique, with a distinct lateral cleft, the maxillary free at tip only, reaching slightly behind front of eye. Length of gape (measured from tip of snout to end of maxillary), $3\frac{1}{8}$ in head; interorbital width, $2\frac{1}{2}$; length of snout (from front of orbit to middle of upper jaw), $3\frac{3}{4}$. Eye small, its greatest oblique diameter 5 to $5\frac{1}{2}$ in head.

Distance from front of dorsal to middle of base of tail equals one-half its distance from tip of snout. The dorsal begins slightly in advance of anal, and ends above its posterior third. Its greatest height equals length of snout and eye.

Caudal truncate when spread. Pectorals broadly rounded, reaching half way to vent. D., 11 or 12 (13 in one specimen); A., 14 (from 13 to 15). Lat. l., 30 or 31, counted to base of caudal rays; 33 or 34 in all.

In spirits the color is dark brown above, sides and below lighter, often irregularly blotched with brown and white. The belly often appears checkered, having centers of scales brown and margins white, or the reverse. Fins all dusky, the basal portions of dorsal and caudal with elongated brown spots on the interradial membranes.

Several specimens were secured at Ash Meadows and in Pahrump Valley, Nevada.

Gasterosteus williamsoni Girard.

Type locality.—Williamson Pass, California.

Four specimens of this species collected by Dr. A. K. Fisher at San Bernardino, California, seem to differ from *G. microcephalus* only in the entire absence of plates on the sides. In *microcephalus* the plates vary from 3 to 7 in number, but no specimens wholly without plates have been reported from the more northern parts of its range. It is probable that *williamsoni* will prove a southern subspecies of this widely distributed form, in which case the plated specimens must bear the name *Gasterosteus williamsoni microcephalus*. The naked form has been reported heretofore from San Bernardino (by Miss Rosa Smith), and from Williamson's Pass by the original describer. The locality of the pass I have not been able to make out.

REPORT ON A SMALL COLLECTION OF INSECTS MADE DURING THE DEATH VALLEY EXPEDITION.

By C. V. RILEY,
With supplementary reports and descriptions of new species by
S. W. WILLISTON, P. R. UHLER, and LAWRENCE BRUNER.

INTRODUCTION.

In connection with the Death Valley Expedition organized by Dr. Merriam arrangements were made to have Mr. Albert Koebele, one of the agents of the Division of Entomology, stationed at Alameda, in California, join the party with a view of making a collection of the insects of the region. He collected assiduously during the brief period of his connection with the expedition, which was suddenly interrupted by a decision to have him proceed to Australia to study and introduce into California certain beneficial insects. He separated from the rest of the party to return to Alameda the latter part of May and the collecting was done during the months of April and May. The material was forwarded without report prior to his leaving for Australia, so that the specimens are, as a rule, without notes, whether of food-plant, or habit. The collection is also necessarily very incomplete in not representing the fauna of the region in the same degree as it would have done had Mr. Koebele been allowed to continue throughout the expedition.

It may be premised in making a report on any such collection as this, that there are few parts of the country, however well explored, that will not yield to the entomologist, in a few days' collecting, a good percentage of species that are new or undescribed, if all orders are taken into consideration, and this being true of the older settled portions of the country, it is true to a far greater extent of such exceptional regions as those included in the Death Valley Expedition. Insects are, also, so numerous in species and specimens, and the undescribed material so vast, that the orders may be compared with the classes in the other groups of animals so far as reporting on them is concerned, and no entomologist would consider himself competent at the present day to intelligently report on any general collection, which must be dealt with by the several specialists who have made particular study of specific families and orders. The part which I have prepared is simply a list of the species easily determinable either by comparison with the national collection or by reference to authorities in the several families, and until the undescribed species and genera are all worked up deductions from the list as to the bearings of the fauna on geographical distribution, must be more or less imperfect and unsatisfactory. Nevertheless, a few suggestions as they occur may not be out of place.

Taking first the Coleoptera, which represent by far the larger part of the collectings, they have for the most part been carefully compared with the national collection, and I have had the assistance, in the verifications, of Mr. M. L. Linell and Mr. E. A. Schwarz, both well acquainted with our North American Coleoptera. Mr. Schwarz has also materially aided in the analysis of the collection. As the chief localities from which the beetles were obtained do not exceed seven, the list has been arranged in tabular series to prevent repetition of localities. This arrangement at once shows that the collection comprises some 258 species, representing 170 genera in 39 families. Of the total number of species arranged according to localities, twenty-eight (*a*) are of general distribution in North America, *i. e.*, they cross the whole continent, and among these are six cosmopolitan species (*a b*), while only a single species (*Bradycellus cognatus*), found in the Argus Mountains, belongs to the circumpolar fauna. About fifty of the species (*c*) are widely distributed throughout the more arid regions of the West, and about twenty species (*d*) belong more properly to the fauna of maritime or upper California. The bulk of these species, as will be noted, were collected in San Bernardino County. Deducting the three sets of species and a few others, *e. g.*, the genera Homalota, Scopæus, Scymnus, and Cryptophagus, of the distribution of which very little can be definitely said, there remain about 140 species (those unlettered) which are more or less characteristic of the lower Sonoran fauna.

Some nineteen species are undoubtedly new, but only a small number of these belong to families that have been worked up and that can be satisfactorily described. They have not been sent away to specialists, as probably no one would care to describe them at once. They will, I hope, be worked up by Mr. Schwarz or Mr. Linell, but not in time for this report. I may mention that the Coleopterous fauna of this general region has been collected and studied by several competent observers. Dr. J. L. LeConte early visited the Colorado Desert and adjacent parts of Arizona; Dr. George H. Horn has also explored the fauna of Owens Valley; Mr. G. R. Crotch collected in a trip across the Mohave Desert; Dr. Edward Palmer collected in southern Utah, while Mr. W. G. Wright has recently made collections in San Bernardino County, and Mr. H. F. Wickham along the line of the Atlantic and Pacific Railroad in northwestern Arizona. Thus Mr. Koebele's small collection adds very little to our knowledge of the species already worked up.

Among the more interesting species Mr. Schwarz has indicated, may be mentioned *Pseudopsis* n. sp., *Mecomycter* n. sp., *Elasmocerus* n. sp., *Cremastochilus westwoodii*, *Alaudes singularis*, *Tanarthrus* n. sp., *Calo-*

spasta n. sp., and a remarkable new genus of Scolytidæ. Perhaps the chief interest attaching to the collection is that it permits us to make some comparison between the beetles of the valleys and intervening mountain chains within the region explored. If we omit those collected in San Bernardino County, which have no exact localities, and also the very few from Coso and Owens Valleys, the following deduction may be made: In Death Valley and Panamint Valley 140 species were found (including 23 species common to both valleys), while in Panamint Mountains and Argus Mountains 160 species were found (including 16 species common to both ranges). Comparing the faunas of the valleys and mountains, it will be noted that they have only 36 species in common. This difference is due principally to the marked preponderance of the Staphylinidæ in the mountain fauna, the complete absence of the family Meloidæ and the marked prevalence of Elateridæ and Chrysomelidæ in the mountain regions. Continued collecting later in the season might have largely changed this condition of things, however, and hence too much importance should not be attached to the deduction. The Carabidæ are the best represented in the collection, 22 genera with 44 species having been collected. The genera are all of wide distribution, and only a few species, *e. g.*, *Omophron dentatum*, *Calosoma prominens*, *Tetragonoderus pallidus*, and *Pinacodera punctigera*, are peculiar to the lower Sonoran region and have all been found in the valleys. The single representative (*Bradycellus cognatus*) of the circumpolar fauna belongs to this family. In most other families the material collected is too small or not characteristic enough to warrant any generalization.

In the Lepidoptera, the Rhopalocera have been determined by comparison with the national collection or by reference to W. H. Edwards, of Coalburgh, W. Va. The majority of the species are characteristic of the southwestern United States, but I have not had time to fully analyze the distribution of the species. The representatives in most of the other families of the Lepidoptera, outside of the Noctuidæ and Geometridæ, are so very few as not to justify consideration. In the Noctuidæ, which are better represented, most of the species have been reported before, but there are a certain number of new species, and Prof. J. B. Smith, of New Brunswick, N. J., to whom these have been referred, finds that they represent even three new genera. In the Geometridæ there are six species which can not be determined either generically or specifically, and which are not included in the list. These undescribed forms have been referred to Dr. George D. Hulst, of Brooklyn, N. Y., who will, I hope, in due time characterize them.

Among the Hymenoptera the Aculeate species comprise genera not restricted to California and include several species which are evidently new. In the parasitic Hymenoptera very little can be said about the collection. The species are most of them new, but this same statement would have to be made of almost any collection of the parasitic forms in this order from any part of the Pacific coast, and would be largely true of almost any part of the country. It is a singular fact, however, that no new genera occur, as will be noticed, in the parasitic families, the most interesting fact worthy of mention being the discovery of what is probably a representative of the genus Scolobates, found heretofore only in northern Europe. The parasitic Hymenoptera were referred to my assistants, Mr. L. O. Howard for the Chalcididæ, and Mr. William H. Ashmead for the other families, and the generic references of the undescribed forms are upon their intimate knowledge of the subject. They will not be able to characterize the many new forms in time for this report.

The Diptera were few in number and were referred to Dr. S. W. Williston, who has characterized the new forms, and whose report shows that, small as was the collection, it added three genera to the American fauna.

In the Heteroptera the list represents merely the species that were readily determinable, while the balance, including the more interesting forms, have been referred to Mr. P. R. Uhler, of Baltimore, Md., who has kindly reported on them, with definitions of the new genera and species.

In the Homoptera, as will be noticed, there are some interesting new species, especially in the family Psyllidæ, but until they are carefully compared, I do not feel justified in making any remarks upon them. Nor have I time just now to characterize the undetermined forms which I prefer to do in connection with the very many new species in the National Collection to which I have already given much study.

The Orthoptera are of considerable interest, although the collection is small. In the Acridiidæ, which probably have been most thoroughly studied in this country, three new species occur and one new genus. The undescribed material has been referred to Mr. Lawrence Bruner, of Lincoln, Nebr., who has reported on the new forms. Probably the most interesting find in this order is the rediscovery of *Scyllina delicatula* Scudder. The type of the species, and the only one hitherto found was taken in the Garden of the Gods. Most of the other species are of rather wide distribution.

The Arachnida were referred to Dr. Geo. Marx and are determined by him.

ORDER COLEOPTERA.

	San Bernardino County.	Death Valley.	Panamint Valley.	Panamint Mountains.	Argus Mountains.	Coso Valley.	Owens Valley.
Family CICINDELIDÆ.							
Cicindela senilis Horn	......	......	......	......	......	......	38
Family CARABIDÆ.							
Omophron dentatum Lec.	4	......	......	......	......	......	19
Calosoma prominens Lec.	......	1	13	......	......	......	......
Clivina punctulata Lec.	1	......	......	......	......	......	......
Dyschirius tridentatus Lec	1	......	......	......	......	......	......
Dyschirius basalis Lec.	1	......	......	......	......	......	......
Dyschirius sphæricollis Say (a)	1	......	......	......	......	......	......
Schizogenius depressus Lec.	......	......	......	1	......	......	......
Bembidium erosum Mots.	......	......	9	......	......	......	......
Bembidium lugubre Lec. (c)	......	......	21	2	......	......	......
Bembidium sculpturatum Mots	......	......	......	......	......	......	1
Bembidium aratum Lec	......	......	8	......	14	......	......
Bembidium n. sp.	......	......	......	......	......	......	1
Bembidium iridescens Lec. (c)	......	......	......	9	7	......	......
Bembidium n. sp.	......	......	......	......	......	......	6
Bembidium ephippiger Lec	......	......	......	......	......	......	2
Bembidium flavopictum Mots. (c)	......	......	1	......	......	......	......
Tachys rapax Lec.	1	......	30	5	......	......	......
Tachys anthrax Lec.	......	......	......	......	2	......	......
Tachys corax Lec	......	......	1	2	......	......	2
Tachys edax Lec.	......	......	......	1	......	......	......
Tachys n. sp.	......	......	26	1	......	......	......
Amara californica Dej. (d)	......	......	1	......	......	......	......
Platynus brunneomarginatus Mannh. (d)	1	......	1	1	2	......	......
Platynus funebris Lec. (d)	3	......	......	......	......	......	......
Lachnophorus elegantulus Mannh.	1	......	......	......	......	......	......
Galerita lecontei Dej. (a)	......	......	1	1	......	......	......
Tetragonoderus pallidus Horn	......	......	1	......	......	......	......
Lebia pleuritica Lec. (a)	......	......	......	......	8	......	......
Lebia guttula Lec. (c)	......	......	......	......	1	......	......
Apristus laticollis Lec. (c)	......	......	1	......	......	......	......
Tecnophilus croceicollis Men.	......	......	3	......	......	......	......
Pinacodera punctigera Lec.	......	......	1	......	......	......	......
Brachynus tschernikhii Mannh. (d)	5	......	......	......	......	......	......
Brachynus costipennis Mots. (d)	10	......	......	......	......	......	......
Chlænius obsoletus Lec	......	......	12	2	......	......	......
Chlænius nemoralis Say (a)	2	......	......	......	......	......	......
Chlænius variabilipes Eschsch. (d)	2	......	......	......	......	......	......
Stenolophus limbalis Lec. (c)	......	......	18	......	......	......	......
Stenolophus flavipes Lec. (c)	......	......	10	......	1	......	......
Bradycellus rupestris Say (a)	......	......	12	4	11	......	......
Bradycellus cognatus Gyllh. (a)	......	......	......	1	1	......	......
Tachycellus nitidus Dej. (c)	2	......	1	......	......	......	......
Anisodactylus californicus Dej. (d)	1	......	1	1	......	......	......
Anisodactylus consobrinus Lec. (d)	......	......	1	1	......	......	......
Family DYTISCIDÆ.							
Cœlambus lutescens Lec. (c)	......	......	1	......	......	......	......
Hydroporus vilis Lec. (c)	......	......	......	......	5	......	......
Hydroporus n. sp	......	......	20	......	......	......	......
Agabinus glabrellus Mots.	......	......	1	......	......	......	......
Agabus n. sp. ?	......	......	3	......	......	......	......
Agabus lecontei Crotch (c)	......	......	1	......	......	......	......
Agabus griseipennis Lec. (c)	......	......	......	......	1	......	......
Agabus lugens Lec	......	......	......	......	2	......	......
Cybister ellipticus Lec.	......	......	3	......	......	......	......
Family HYDROPHILIDÆ.							
Hydrophilus triangularis Say (a)	......	......	2	......	......	......	......
Hydrophilus californicus Lec	......	......	4	......	......	......	......
Ochthebius rectus Lec	......	......	3	......	......	......	......
Helochares normatus Lec	......	......	16	......	......	......	......
Cymbiodyta imbellis Lec.	......	......	......	......	11	......	......
Family SILPHIDÆ.							
Necrophorus nigrita Mannh. (d)	......	......	1	......	......	......	......
Necrophorus guttula Mots. (d)	......	......	1	......	......	......	......

ORDER COLEOPTERA—Continued.

	San Bernardino County.	Death Valley.	Panamint Valley.	Panamint Mountains.	Argus Mountains.	Coso Valley.	Owens Valley.
Family Pselaphidæ.							
Bryaxis deformata Lec				22			
Bryaxis foveata Lec				47			
Family Staphylinidæ.							
Falagria sp			2	26			
Falagria sp				2			
Falagria sp				2			
Myrmedonia sallei Sharp (*a*)				14			
Homalota sp					19		
Homalota sp			1				
Homalota sp				8			
Homalota sp		6	1				
Aleochara bimaculata Grav. (*ab*)					2		
Gyrophæna sp. (*c*)			2				
Quedius limbifer Horn (*c*)			1	15	12		
Philonthus filicornis Horn					8		
Philonthus decipiens Horn					1		
Philonthus parvus Horn				20	17		
Actobius puncticeps Horn				10	32		
Xantholinus pusillus Sachse. (*a*)			3				
Leptacinus brunnescens Lec. (*c*)				1			
Cryptobium californicum Lec. (*d*)				20			
Scopæus sp				1			
Scopæus sp				10	1		
Scopæus sp				1			
Scopæus sp				3			
Tachinus debilis Horn					9		
Tachyporus californicus Horn (*c*)					10		
Bledius ferratus Lec			9	20			
Bledius nitidiceps Lec	1						
Bledius armatus Er							1
Trogophlœus sp				1			
Pseudopsis n. sp				1	1		
Homalium n. sp					4		
Anthobium n. sp. (princeps Fauv. i. litt.) (*c*)					19		
Orobanus densus Casey				1			
Family Phalacridæ.							
Phalacrus ovalis Lec. (*c*)		1					
Family Corylophidæ.							
Sericoderus subtilis Lec. (*c*)			21				
Family Coccinellidæ.							
Hippodamia convergens Guér. (*a*)		3	3	2	1		
Hippodamia 5-signata Kirb. (*a*)		3	1	20	1		
Coccinella abdominalis Say (*a*)		1					
Mysia hornii Crotch (*c*)					1		
Psyllobora tædata Lec. (*a*)		2	3		15		
Pentilia n. sp					11		
Scymnus coniferarum Crotch					18		
Scymnus sp			1				
Scymnus sp				1			
Scymnus sp					1		
Family Colydiidæ.							
Anchomma costatum Lec					1		
Family Cryptophagidæ.							
Cryptophagus sp			12				
Family Dermestidæ.							
Attagenus piceus Oliv. (*ab*)					3		
Perimegatoma cylindricum Kirb. (*c*)					3		
Perimegatoma variegatum Horn			1		1		
Trogoderma ornatum Say (*ab*)		2	6				
Anthrenus scrophulariæ Linn. (*ab*)		3					

ORDER COLEOPTERA—Continued.

	San Bernardino County.	Death Valley.	Panamint Valley.	Panamint Mountains.	Argus Mountains.	Coso Valley.	Owens Valley.
Family HISTERIDÆ.							
Saprinus ciliatus Lec. (c)	......	......	......	......	1	......	......
Saprinus lubricus Lec. (c)	......	......	......	......	9	......	......
Saprinus laridus Lec	......	......	......	......	......	......	3
Family NITIDULIDÆ.							
Carpophilus yuccæ Crotch	......	......	......	......	5	......	......
Carpophilus pallipennis Say (a)	......	......	29	......	......	......	......
Family LATHRIDIIDÆ.							
Stephostethus liratus Lec. (a)	......	......	1	3	......	......	......
Lathridius filiformis Gyllh. (ab)	......	......	3	......	......	......	......
Corticaria cavicollis Mannh. (a)	......	......	9	9	5	......	......
Family BYRRHIDÆ.							
Limnichus californicus Lec	......	......	1	......	......	......	......
Family DASCYLLIDÆ.							
Cyphon concinnus Lec. (c)	......	......	......	1	......	......	......
Family ELATERIDÆ.							
Cardiophorus seniculus Blanch	......	......	......	......	1	......	......
Cardiophorus obscurus Lec	......	......	......	......	1	......	......
Anchastus sericeus Horn	......	......	......	......	1	......	......
Melanotus longulus Lec	......	......	......	......	1	......	......
Dolopius lateralis Eschsch. (a)	2	......	......	1	3	......	......
Melanactes densus Lec	......	......	......	......	1	......	......
Family BUPRESTIDÆ.							
Buprestis læta Lec. (c)	......	......	1	......	......	......	......
Anthaxia æneogaster Lap. (a)	......	......	......	......	1	......	......
Chrysobothris octocola Lec	......	2	2	......	......	......	......
Chrysobothris debilis Lec	......	9	15	......	......	......	......
Acmæodera tuta Horn	......	2	......	......	1	......	......
Acmæodera connexa Lec	......	......	......	......	1	......	......
Family LAMPYRIDÆ.							
Podabrus tomentosus Say (a)	......	......	......	1	......	......	......
Silis n. sp	......	......	......	......	2	......	......
Silis filigera Lec	......	......	1	......	......	......	......
Malthodes n. sp	......	......	......	......	1	......	......
Family MALACHIIDÆ.							
Malachius macer Horn	......	......	......	......	2	......	......
Malachius mirandus Lec	......	......	......	......	1	......	......
Malachius n. sp	......	......	......	......	5	......	......
Attalus trimaculatus Mots	......	2	4	......	......	......	......
Pristoscelis conformis Lec	......	......	3	......	......	......	......
Pristoscelis sp	......	......	28	14	......	......	......
Pristoscelis sp	......	......	......	......	......	......	2
Pristoscelis sp	......	......	14	......	2	......	......
Listrus luteipes Lec	......	......	......	......	11	......	......
Listrus difficilis Lec	......	......	......	......	9	......	......
Listrus sp	......	2	4	......	......	......	......
Dolichosoma n. sp	......	......	9	6	......	......	......
Dolichosoma n. sp	......	......	......	......	2	......	......
Allonyx sculptilis Lec	......	......	......	......	12	......	......
Eschatocrepis constrictus Lec	......	......	......	......	12	......	......
Hemomyster n. sp	......	......	90	......	......	......	......
Family CLERIDÆ.							
Elasmocerus n. sp	......	......	1	......	......	......	......
Trichodes ornatus Say (c)	......	......	29	......	2	......	......
Hydnocera discoidea Lec	......	12	7	......	......	......	......
Lebasiella n. sp	......	......	1	1	......	......	......

ORDER COLEOPTERA—Continued.

	San Bernardino County.	Death Valley.	Panamint Valley.	Panamint Mountains.	Argus Mountains.	Coso Valley.	Owens Valley.
Family PTINIDÆ.							
Ernobius sp.					8		
Sinoxylon declive Lec.					1		
Amphicerus fortis Lec			3				
Family SCARABÆIDÆ.							
Aphodius granarius Linn. (ab)					2		
Aphodius rubidus Lec	1						
Atænius abditus Hald. (a)	4						
Oncerus floralis Lec			2				
Diplotaxis corvina Lec.		3					
Cotalpa granicollis Hald.					1		
Cremastochilus westwoodii Horn						1	
Family CERAMBYCIDÆ.							
Haplidus testaceus Lec.					2		
Family CHRYSOMELIDÆ.							
Coscinoptera vittigera Lec. (c)					1		
Lema nigrovittata Guér.			4	2			
Exema conspersa Mannh. (a)	1						
Cryptocephalus sanguinicollis Suffr (c)					2		
Pachybrachys n. sp	1						
Pachybrachys sp		27		1	1		
Pachybrachys lustrans Lec			1				
Glyptoscelis illustris Crotch.					10		
Metachroma californicum Lec.				1			
Plagiodera n. sp.					1		
Monoxia consputa Lec. (c)				1			
Haltica carinata Germ. (a)					11		1
Epitrix subcrinita Lec. (c)					11		
Phyllotreta albionica Lec. (c)					7		
Psylliodes convexior Lec. (c)					2		
Family BRUCHIDÆ.							
Bruchus prosopis Lec.		8	6				
Bruchus protractus Horn		7	1				
Bruchus n. sp.		18	1				
Family TENEBRIONIDÆ.							
Triorophus lævis Lec	2		1				
Triorophus subpubescens Horn					1		
Eurymetopon rufipes Eschsch. (d)	4	12	2				
Anepsius delicatulus Lec	1						
Centrioptera muricata Lec	1						
Schizillus laticeps Horn						3	
Cryptoglossa verrucosa Lec	1	15	1			1	
Coniontis viatica Eschsch. (d)	2						
Eusattus productus Lec.			1				
Eleodes granosa Lec.			1			2	
Eleodes grandicollis Mannh. (d)					2		
Eleodes armata Lec		7		1	2	3	
Eleodes carbonaria Say (c)	2			1		1	
Eleodes gracilis Lec.						1	
Eulabis rufipes Eschsch					2		
Cerenopus concolor Lec	1						
Cœlocnemis magna Lec			8		8	8	
Blapstinus dilatatus Lec	1						
Blapstinus brevicollis Lec			2				
Blapstinus rufipes Casey			5				
Conibiosoma elongatum Horn	1		5		2		
Notibius puberulus Lec	1		3				
Alaudes singularis Horn					1		
Family OTHNIIDÆ.							
Othnius umbrosus Lec. (c)					1		
Family PYTHIDÆ.							
notus macer Horn					1		

ORDER COLEOPTERA—Continued.

	San Bernardino County.	Death Valley.	Panamint Valley.	Panamint Mountains.	Argus Mountains.	Coso Valley.	Owens Valley.
Family MORDELLIDÆ.							
Anaspis pusio Lec				6			
Family ANTHICIDÆ.							
Notoxus cavicornis Lec					4		
Anthicus confinis Lec			1				
Anthicus difficilis Lec (a)	2						
Anthicus nitidulus Lec (c)					10		
Anthicus californicus Laf (a)							7
Tanarthrus n. sp			3				
Family MELOIDÆ.							
Megetra opaca Horn			1				
Cysteodemus armatus Lec			23				
Nemognatha lutea Lec			2				
Nemognatha apicalis Lec		1					
Epicauta n. sp		1	1				
Cantharis magister Horn			28				
Calospasta n. sp			26				
Calospasta mirabilis Horn			1				
Phodaga alticeps Lec		1	5				
Family OTIORHYNCHIDÆ.							
Eupagoderes varius Lec		1	1		1		
Eupagoderes geminatus Lec		11	1				
Eupagoderes n. sp		15					
Nov. gen. and n. sp			2				
Nov. gen. and n. sp	1						
Family CURCULIONIDÆ.							
Sitones vittatus Lec (d)					3		
Apion ventricosum Lec		39	3	2			
Apion vicinum Smith					20		
Apion antennatum Smith			22		13		
Lixus 4-lineatus Chevr (c)					1		
Cleonus vittatus Kirb (c)			1				
Smicronyx n. sp					1		
Smicronyx cinereus (a)		10	5	1	53		
Anthonomus peninsularis Dietz					4		
Anthonomus ebeninus Dietz					14		
Macrorhoptus estriatus Lec (c)					10		
Tychius semisquamosus Lec					1		
Tychius setosus Lec		13	29	1			
Copturus longulus Lec (a)					1		
Centorhynchus rapæ Gyllh (ab)					3		
Centorhynchus n. sp			1				
Family CALANDRIDÆ.							
Scyphophorus yuccæ Horn					14		
Sphenophorus pictus Lec			1				
Sphenophorus simplex Lec (c)			4				
Family SCOLYTIDÆ.							
Pityophthorus sp					28		
Pityophthorus sp					22		
Nov. gen. (near Cryphalus), n. sp					2		
Family ANTHRIBIDÆ.							
Brachytarsus tomentosus Say (a)					1		

Order LEPIDOPTERA.

Family NYMPHALIDÆ.

Melitæa acastus Edw ....13 ex., Argus Mountains.
Melitæa alma Streck.......................15 ex., Coso Valley; 1 ex., Panamint Valley; 1 ex., Argus Mountains.
Pyrameis cardui L.......................1 ex., San Bernardino County, and abundant everywhere on trip, and migrating towards northwest.
Pyrameis caryæ Hb ....2 ex., Argus Mountains.

Family LYCÆNIDÆ.

Lemonias mormo Feld ....1 ex., Argus Mountains; 1 ex., Panamint Mountains; 1 ex., Panamint Valley.
Thecla dumetorum Bd.......................1 ex., San Bernardino County; 5, Coso Valley; 2, Argus Mountains.
Thecla spinetorum Bd.......................3 ex., Argus Mountains; 1, Panamint Mountains.
Lycæna acmon Doubl ....1 ex., Panamint Valley; 1, Argus Mountains.
Lycæna amyntula Bd ....8 ex., Coso Valley; 1, Panamint Valley; 2 Argus Mountains.
Lycæna exilis Bd ....1 ex., Argus Mountains; 1, Death Valley; 2, Panamint Valley.
Lycæna daedalus Behr ....1 ex., Death Valley.
Lycæna neglecta Edw ....1 ex., Coso Valley; 1, Death Valley.
Lycæna lygdamas Dd ....2 ex., Argus Mountains.
Lycæna oro Scudd ....4 ex., Argus Mountains.
Lycæna pheres, var. *evius* Bd.......................1 ex., Argus Mountains; 2, Coso Valley.
Lycæna battoides Behr ....2 ex., Argus Mountains.

Family PAPILIONIDÆ.

Pieris beckerii Edw.......................2 ex., Argus Mountains.
Pieris sisymbrii Bd.......................26 ex., Argus Mountains.
Anthocharis cethura Feld.......................19 ex., Argus Mountains.
Anthocharis ausonides Bd.......................15 ex., Argus Mountains; 2, Panamint Mountains; 5, Coso Valley; 6, Paradise Valley.
Colias ariadne Edw.......................1 ex., Coso Valley.
Papilio zolicaon Bd.......................5 ex., Argus Mountains; 1, San Bernardino County.

Family HESPERIDÆ.

Copæodes procris Edw ....1 ex., Argus Mountains.
Pamphila nevada Scud.......................1 ex., Argus Mountains.
Pamphila phylæus Dru ....1 ex., Death Valley.
Pyrgus tesselata Scud.......................1 ex., Argus Mountains.
Pyrgus ericetorum Bd.......................9 ex., Coso Valley; 3, Argus Mountains.
Nisoniades alpheus Edw.......................2 ex., Argus Mountains; 1, Coso Valley.
Eudamus nevada Scud.......................1 ex., Argus Mountains.

Family SPHINGIDÆ.

Lepisesia phaëton G. and R..................1 ex., San Bernardino County.

Family SESIIDÆ.

Sesia sp..................................2 ex., Argus Mountains.

Family AGARISTIDÆ.

Alypia ridingsii Gr.......................3 ex., Argus Mountains; 1, Panamint Mountains; 1, San Bernardino County.

Family PYROMORPHIDÆ.

Triprocris smithsonianus Clem..............5 ex., Argus Mountains.

Family ARCTIIDAE.

Leptarctia decia Bd.......................2 ex., Argus Mountains.

Family NOTODONTIDÆ.

Cerura n. sp..............................3 ex., Owens Valley.

Family COSSIDÆ.

Hypopta bertholdi Grt.....................1 ex., Argus Mountains.

Family NOCTUIDÆ.

Melipotis jucunda Hb ....1 ex., Panamint Mountains.
Syneda howlandii Gr ....1 ex., Argus Mountains.
Cirrhobolina deducta Morr..................1 ex., Death Valley
Hypena pelligera Smith.....................1 ex., Panamint Valley.
Grotella dis Gr ....24 ex., Argus Mountains.
Thalpochares arizonæ H. Edw ....10 ex., Argus Mountains.
Mamestra curialis Grt......................18 ex., Argus Mountains.
Mamestra crotchii Grt......................2 ex., Argus Mountains
Acontia cretata Grt. and Robs..............8 ex., Argus Mountains.
Acontia lanceolata Grt ....6 ex., Argus Mountains.
Triocnemis saporis Grt ....1 ex., Argus Mountains.
(Much paler than typical form.)
Melicleptria n. sp.........................1 ex., Argus Mountains.
Oncocnemis ? n. sp.........................5 ex., Argus Mountains.
Schinia sp.................................3 ex., Argus Mountains.
Schinia n. sp..............................20 ex., Argus Mountains.
Antaplaga n. sp............................5 ex., Argus Mountains.
Heliophana n. sp...........................1 ex., Argus Mountains.
Nov. gen. et n. sp...........................7 ex., Argus Mountains.
Nov. gen. et n. sp...........................3 ex., Argus Mountains.
Nov. gen. et n. sp. (congeneric with above)..6 ex., Argus Mountains.
Scotogramma n. sp. (?).....................8 ex., Argus Mountains.
Nov. gen. et n. sp...........................1 ex., Argus Mountains.
Noctua havilae Grt.........................2 ex., Argus Mountains.
Plusia sp. (badly rubbed.).................2 ex., Argus Mountains.
Agrotis (sens. lat.) n. sp..................3 ex., San Bernardino County.
Homoptera mima var.........................4 ex., Death Valley.
Pleonectyptera n. sp.......................2 ex., Argus Mountains.

Family Geometridæ.

Azelina hübnerata Gn	4 ex., Argus Mountains.
Azelina meskearia Pack	8 ex., Argus Mountains.
Hetæra ephelidaria Hulst	1 ex., Panamint Valley; 1 ex., Argus Mountains.
Anaplodes festaria Hulst	2 ex., Argus Mountains.
Nemoria phyllinaria Zell	2 ex., Panamint Valley.
Semiothisa metanemaria Hulst	2 ex., Argus Mountains.
Semiothisa californiata Pack	12 ex., Argus Mountains; 3 ex., Death Valley; 2 ex., San Bernardino County; 1 ex., Coso Valley.
Phasiane sp	1 ex., Argus Mountains.
Phasiane meadiata Pack	8 ex., Panamint Valley.
Phasiane neptata Gn	1 ex., Panamint Mountains.
Marmopteryx tesselata Pack	1 ex., Coso Valley; 1, Argus Mountains.
Lepiodes escaria Gr	1 ex., Panamint Valley.
Lepiodes behrensata Pack	1 ex., San Bernardino County.
Gorytodes n. sp	3 ex., Argus Mountains.
Boarmia furfuraria Hulst	2 ex., Argus Mountains.
Eupithæcia rotundopennata Pack	1 ex., Death Valley.
Eupithæcia zygadæniata Pack	1 ex., Argus Mountains.
Eupithæcia taeniata Hulst	2 ex., Argus Mountains.
"*Coremia defensaria*" according to label by Packard in collection, Hulst.	9 ex., Argus Mountains; 1 ex., Death Valley.

Family Phycitidæ.

Ortholepis near *jugosella* Rag	12 ex., Argus Mountains.
Ephestia nigrella Hulst	1 ex., Death Valley.
Lipographis fenestrella Pack. var	1 ex., Death Valley.
Homeosoma mucidellum Rag	2 ex., Death Valley.

Order HYMENOPTERA.

Family Apidæ.

Xylocopa sp	2 ex., Panamint Valley.
Xylocopa sp	2 ex., Panamint Mountains.
Anthophora sp	2 ex., Panamint Mountains.
Diadasia sp	10 ex., Coso Valley.
Diadasia sp	1 ex., Panamint Valley.
Melissodes sp	1 ex., Panamint Valley.
Anthidium sp	1 ex., Panamint Valley.
Osmia sp	1 ex., Death Valley.
Nomada sp	1 ex., Death Valley.
Perdita (Macrotera) cephalotes Cr	2 ex., Panamint Mountains.
Panurgus sp	1 ex., Panamint Valley.
Panurgus sp	5 ex., Panamint Mountains.

Family Andrenidæ.

Macropis sp	5 ex., Panamint Valley.
Cilissa albihirta Ashm	1 ex., Panamint Valley.
Cilissa sp	2 ex., Panamint Valley.
Halictus sp	1 ex., Panamint Valley.

Family SPHECIDÆ.

Prionoxyx thomæ Fabr........................1 ex., Panamint Valley.

Family MASARIDÆ.

Masaris sp................................1 ex., Death Valley.

Family EUMENIDÆ.

Odynerus sp................................1 ex., Panamint Valley.
Odynerus sp................................1 ex., Death Valley.
Ancistrocerus sp...........................2 ex., Argus Mountains.
Ancistrocerus sp...........................1 ex., Death Valley.
Ancistrocerus sp...........................1 ex., Argus Mountains.

Family MUTILLIDÆ.

Sphærophthalma sp.........................2 ex., Death Valley.
Sphærophthalma sp.........................1 ex., Panamint Valley.
Sphærophthalma sp.........................1 ex., Argus Mountains.

Family FORMICIDÆ.

Camponotus castaneus Latr...................1 ex., Argus Mountains.
Formica integra Nyl.........................1 ex., Argus Mountains.
—— —— male...........................1 ex., Panamint Mountains.

Family MYRMECIDÆ.

Aphænogaster pergandei Mayr................Lone Pine.

Family BRACONIDÆ.

Bracon sp.................................1 ex., Argus Mountains.
Bracon sp.................................2 ex., Argus Mountains.
Bracon sp.................................1 ex., San Bernardino County.
Microbracon sp.............................1 ex., Argus Mountains.
Microbracon sp.............................1 ex., Monterey County.
Microbracon sp.............................2 ex., Argus Mountains.
Microbracon sp.............................1 ex., Santa Clara County.
Microbracon sp.............................1 ex., Argus Mountains.
Heterospilus sp............................1 ex., Argus Mountains.
Bathystomus sp.............................1 ex., Argus Mountains.
Chelonus sp................................1 ex., Argus Mountains.
Acœlius sp.................................1 ex., Death Valley.
Apanteles sp...............................8 ex., Argus Mountains.
Apanteles sp...............................1 ex., Death Valley.
Microplitis sp.............................1 ex., Panamint Valley.
Agathis vulgaris Cr........................2 ex.; 1, Argus Mountains; 1, Panamint Valley.
Agathis nigripes Cr........................1 ex., Argus Mountains.
Euphorus mellipes Cr.......................1 ex., Argus Mountains.
Lysiphlebus cucurbitaphis Ashm.............2 ex., Monterey County.

Family ICHNEUMONIDÆ.

Cryptus sonorius Cr., female.................2 ex., Death Valley.
Ophion bilineatum Say.......................1 ex., Sonoma County.
Limneria cupressi Ashm......................1 ex., Argus Mountains.

Limneria fugitiva Say........................1 ex., Monterey County.
Scolobates sp. (or a new genus closely allied)..1 ex., Argus Mountains. (Collected on *Pinus monophylla*.)
Anomalon sp ....1 ex., Argus Mountains.
Plectiscus sp...............................1 ex., Death Valley.
Exetastes sp ....1 ex., Argus Mountains.
Banchus spinosus Cr ....1 ex., Panamint Valley.
Orthocentrus sp.............................2 ex., Argus Mountains.
Pimpla novita Cr............................9 ex., Argus Mountains. (Collected on *Pinus monophylla*.)

Family PROCTOTRYPIDÆ.

Ceraphron sp ....1 ex., Argus Mountains.
Ceraphron sp ....2 ex., Panamint Mountains.

Family CHALCIDIDÆ.

Leucaspis affinis Say.......................1 ex., San Bernardino County.
Chalcis sp..................................2 ex., Death Valley.
Chalcis sp..................................1 ex., San Bernardino County.
Chalcis sp..................................1 ex., San Bernardino County.
Acanthochalcis sp ....1 ex., Panamint Valley.
Decatoma sp.................................1 ex., San Bernardino County.
Isosoma sp ....15 ex., Argus Mountains.
Ashmeadia sp ....2 ex. (Collected on *Pinus monophylla*.)
Systole sp ....1 ex., Argus Mountains.
Perilampus sp ....2 ex., San Bernardino County.
Perilampus sp ....1 ex., San Bernardino County.
Holaspis sp.................................1 ex., Death Valley.
Torymus sp..................................3 ex., Argus Mountains; 1 on *Pinus monophylla*.
Torymus sp..................................29 ex., Argus Mountains; 13 on *Pinus monophylla*.
Syntomaspis sp ....1 ex., San Bernardino County.
Metapelma sp................................1 ex., Panamint Mountains.
Ratzeburgia sp..............................1 ex., Argus Mountains.
Eupelmus sp.................................1 ex., Argus Mountains. (Collected on *Pinus monophylla*.)
Eupelmus sp.................................1 ex., Argus Mountains. (Collected on *Pinus monophylla*.)
Antigaster sp., male........................1 ex., San Bernardino County. Reared from eggs of a *Phaneroptera*.
Polychroma sp...............................1 ex., Death Valley; 1, Panamint Valley; 1, Argus Mountains.
Encyrtus sp ....2 ex., Argus Mountains.
Dibrachys sp ....32 ex., Argus Mountains.
Eutelus sp..................................1 ex., Argus Mountains.
Isocyrtus sp ....2 ex., Owens Valley.
Arthrolytus sp..............................1 ex., Panamint Mountains.
Meraporus sp ....2 ex., Argus Mountains.
Platyterma sp ....2 ex., Argus Mountains.
Anogmus sp ....1 ex., Argus Mountains.
Euplectrus sp...............................1 ex., Argus Mountains.
Teleogmus sp................................1 ex., Monterey County.
Olinx sp....................................2 ex., Argus Mountains.

Sympiesus sp ....1 ex., Argus Mountains.
Omphale sp ....1 ex., Argus Mountains.
Entedon sp ....1 ex., Argus Mountains.
Chrysocharis sp ....1 ex., Argus Mountains.
Euderus sp ....4 ex., Argus Mountains.
Tetrastichus sp. (3 species) ....8 ex., Argus Mountains, Panamint Valley, and Death Valley.

Order HETEROPTERA.

Family CORIMELÆNIDÆ.

Corimelæna extensa Uhler ....11 ex, Panamint Mountains; 2 Panamint Valley; 1 Argus Mountains.

Family PENTATOMIDÆ.

Brochymena obscura H. Sch ....1 ex., Panamint Valley.
Liodeerma sayi Stål ....1 ex., Panamint Valley.
Peribalus limbolarius Stål ....1 ex., Panamint Valley.
Thyanta rugulosa Say ....1 ex., Argus Mountains.
14 ex., Nev. 671.
Carpocoris lynx Fabr ....1 ex., Panamint Valley.
Dendrocoris pini Mont ....9 ex., Argus Mountains, on *Pinus monophylla*.

Family COREIDÆ.

Ficana apicalis Dall ....3 ex., Argus Mountains, on *Pinus monophylla*.
4 ex., Panamint Valley.
Harmostes reflexulus Stål ....1 ex., Death Valley.
Corizus lateralis Say ....1 ex., Argus Mountains, on *Pinus monophylla*.

Family BERYTRIDÆ.

Neides muticus Say ....1 ex., Argus Mountains.

Family LYGÆIDÆ.

Nysius angustatus Uhler ....15 ex., Argus Mountains.
Ischnorhynchus didymus Zett ....1 ex., Argus Mountains.
Cymodema tabida Spin ....1 ex., Owens Valley; 1 Panamint Mountains.
Eremocoris tropicus Dist ....4 ex., Argus Mountains.
Melanocoryphus bicrucis Say ....1 ex., Argus Mountains, on *Pinus monophylla*.
Lygæus reclivatus Say ....1 ex., Panamint Valley.

Family PYRRHOCORIDÆ.

Largus cinctus H. Sch ....1 ex., Argus Mountains; 1 ex., Coso Valley; 1 ex., Panamint Valley.

Family CAPSIDÆ.

Campsocerocoris annulicornis Reut ....2 ex., Argus Mountains, on *Pinus monophylla*.
Hadronema robusta Uhler ....1 ex., Owens Valley.

Lygus pratensis Linn .... 1 ex., Death Valley.
Lygus invitus Say .... 2 ex., Death Valley.
Dicyphus secundus Uhler .... 5 ex., Argus Mountains.

Family ANTHOCORIDÆ.

Triphleps insidiosus Say .... 1 ex., Panamint Valley.

Family TINGITIDÆ.

Tingis arcuata Say .... 5 ex., Argus Mountains.
Corythuca ciliata Say. var .... 25 ex., Argus Mountains.

Family NABIDÆ.

Coriscus ferus Linn .... 1 ex., Death Valley.

Family REDUVIIDÆ.

Diplodus socius Uhler .... 2 ex., Panamint Valley; 1, Panamint Mountains.
Apiomerus ventralis Say .... 1 ex., Panamint Valley.
Ginea rileyi Mont .... 5 ex., Death Valley; 4 ex., Panamint Valley.

Family VELIIDÆ.

Hebrus pucellus Burm .... 2 ex., Panamint Mountains.
Macrovelia hornii Uhler .... 2 ex., Argus Mountains.

Family SALDIDÆ.

Species of Salda undetermined.

Family GALGULIDÆ.

Mononyx stygicus Say .... 3 ex., Panamint Valley.

Family NOTONECTIDÆ.

Anisops platycnemis Fieb .... 1 ex., Death Valley.

Order HOMOPTERA.

Family FULGORIDÆ.

Delphax tricarinatus Say .... 1 ex., Argus Mountains, on *Pinus monophylla*.
Cixius stigmatus Say .... 1 ex., Argus Mountains, on *Pinus monophylla*.

Family MEMBRACIDÆ.

Platycentrus acuticornis Stål .... 20 ex., San Bernardino County.
Centrodus atlas Goding .... 48 ex., Death Valley.
Multareis cornutus Goding .... 2 ex., Panamint Valley.

Family BYTHOSCOPIDÆ.

Agallia siccifolia Uhler .... 12 ex., Argus Mountains, on *Pinus monophylla*.

Family CERCOPIDÆ.

Proconia hieroglyphica Say ....1 ex., Argus Mountains.
Proconia costalis Fabr.........................1 ex., Argus Mountains, on *Pinus monophylla.*

Family JASSIDÆ.

Several species not determined.

Family PSYLLIDÆ.

Aphalara n. sp..............................23 ex., Argus Mountains, May, 1891.
Aphalara n. sp..............................5 ex., Argus Mountains, May, 1891.
Aphalara n. sp..............................5 ex., Argus Mountains, May, 1891.
Aphalara n. sp..............................23 ex., Death Valley, April, 1891.
N. g. et. n. sp..............................34 ex., Panamint Mountains and Argus Mountains.
Psylla n. sp..................................47 ex., Argus Mountains, April and May, 1891.
Psylla n. sp..................................40 ex., Argus Mountains, April and May, 1891.
(?) *Psylla* n. sp ....1 ex., Argus Mountains, May, 1891.
Trioza n. sp...................................136 ex., Death Valley and Argus Mountains.

Order ORTHOPTERA.

Family FORFICULIDÆ.

Tridactylus n. sp.............................3 ex., San Bernardino County; 1 ex., Lone Pine. (A. K. Fisher.)

Family BLATTIDÆ.

Heterogamia sp. (probably new).............1 ex.

Family GRYLLIDÆ.

Nemobius sp. (probably new)..................1 ex.
Gryllus abbreviatus Serv. (?)..................4 ex., Panamint Valley; 2, Argus Mountains.

Family LOCUSTIDÆ.

Stenopelmatus talpa Burm....................1 ex., Panamint Valley.

Family ACRIDIIDÆ.

Paratettix mexicanus Sauss ....8 ex., Panamint Valley.
Paratettix toltecus Sauss. (not quite typical)..17 ex., Panamint Valley.
Dracotettix n. sp.............................6 ex., Panamint Valley.
Haldemanella robusta Brun..................1 ex., Argus Mountains.
Hippiscus latertius Sauss (var)..............8 ex., Argus Mountains; 4, Panamint Valley.
Hippiscus aurilegulus Scudd..................1 ex.
Anconia integra Scudd. (modified in color)...8 ex., Death Valley.

Encoptolophus n. sp	19 ex., Panamint Valley; 5 ex., Death Valley.
Scirtettica n. sp	1 ex.
Scyllina delicatula Scudd	1 ex.
N. gen. et n. sp.; between *Œdipoda and Erimobia*	1 ex.
Leptysma mexicana Sauss	18 ex., Panamint Valley.
Psoloessa texana Scudd	3 ex., Coso Valley
Trimerotropis vinculata Scudd	3 ex., Panamint Valley.
Thrincus aridus Brun	2 ex., Panamint Valley.
Camnula pellucida	Several ex., Walker Basin. (Dr. A. K. Fisher.)

ARACHNIDA.

Family Ixodidæ.

Argas occidentalis Marx	From dog's ear, Ash Meadows, Nev., March 9, 1891. (A. K. Fisher.)
Rhipistoma leporis Marx	From rabbit's ear, Kern River, Calif., July 4, 1891. (A. K. Fisher.)
Ixodes ricinus L	From Thomomys, Walker Pass, Calif., July 1. 1891. (A. K. Fisher.)
Rhipicephalus angustipalpis Marx	From jack rabbit, Daggett, Calif., Jan. 7, 1891. (A. K. Fisher.)
Dermacentor americanus L	From child's ear, Lone Pine, Calif., June 9, 1891. (A. K. Fisher.)

Family Scorpionidæ.

Vejovis punctipalpis Wood	1 ex. (A. K. Fisher), Panamint Mountains, April.

LIST OF DIPTERA OF THE DEATH VALLEY EXPEDITION.

By S. W. Williston.

The following pages include a list of the species contained in a small collection of Diptera from Death Valley and the adjoining regions, sent me recently for determination by Prof. Riley. That the larger part of them should be new to science is not at all strange, inasmuch as they are, for the greater part, members of families which have been but little studied in America. The collection is of considerable interest as adding three European or African genera hitherto unrecorded from America, among which the wingless *Apterina* is the most remarkable. After careful search I have found it necessary to describe two new genera—one among the Dexiidæ, the other an Ephydrinid.

Culex inornatus n. sp.

Female.—Palpi yellowish brown. Proboscis yellowish, black at the tip. Antennæ black, the basal joints yellowish. Occiput black, clothed mostly with whitish pubescence. Thorax red, the dorsum reddish brown, thinly clothed with light yellow and white tomentum, and blackish bristly hairs. Pleuræ with white tomentum. Abdomen black, somewhat yellowish in ground-color on the second and third segments, covered with white scale-like tomentum on the front and sides of the segments, on the posterior part of the segments with blackish tomentum. Legs brownish; on the inner side thickly, on the outer side thinly, covered with white tomentum. Wings nearly hyaline, the tomentum of the veins blackish. Length, 5-6^{mm}.

One specimen, Argus Mountains, April, 1891 (Koebele). Both this and the following species belong to the genus *Culex* in the restricted sense of Lynch.

Culex n. sp.

Female.—Dark brown or black, the occiput covered with white and brown tomentum. Palpi black, at the tip silvery. Proboscis black, with a white ring beyond the middle. Antennæ black. Dorsum of thorax covered with brown and white tomentum, the white toward either side posteriorly, and forming two slender lines, abbreviated anteriorly. Pleuræ with white tomentum. Abdomen deep brown, with six conspicuous rings of white tomentum on the anterior part of the segments, the ground-color under them yellow; on the second segment a white tomentose spot in front. Legs nearly black, the base of all the femora yellowish. On the outer side of the femora, in large part, and along the whole inner side of the legs, as also moderately broad rings at the articulations of all the tarsal joints, white. Wings nearly hyaline; tomentum blackish, distributed nearly evenly on the veins. Length, 6^{mm}.

One specimen, Argus Mountains, Calif., April. This species is closely allied to *C. annulatus* Meigen, which occurs in the western regions and in Mexico, but seems to differ in the uniformly distributed tomentum of the wings.

Simulium argus n. sp.

Female.—Black, the legs in part light yellow. Front black, opaque. Face cinereous, with whitish pubescence. Antennæ brownish black, the basal joint yellowish. Thorax black, the dorsum thinly pollinose, not shining; pleuræ densely white pollinose, with a black spot. Abdomen opaque velvety black, the first three segments with a narrow silvery white spot on either side at the hind margin; the next three segments similarly marked, but the interval between the spots successively wider, and each with two other, successively larger, white spots, leaving a black space in the middle and a narrower one at the outer sides. Venter white. Legs brownish black, the distal part of the femora, base of tibiæ, and the greater part of the metatarsi light yellow. Wings pure hyaline, the veins light colored, those posteriorly very delicate. Length, $2\frac{1}{2}^{mm}$.

One specimen, Argus Mountains, Calif., May, 1891.

Psilocephala n. sp.?

A single male specimen. Panamint Valley, April.

Thereva vialis Osten Sacken, Western Dipt., 274.

A single male specimen, Death Valley, Calif., April, 1891.

Erax aridus sp. [var.] n.

A single female specimen, considerably larger than the type of *E. latrunculus* Will. differs from that species in the legs being wholly black, the hair of the face being wholly white, and in the furcation of the third vein taking place opposite, instead of distinctly beyond the base of the second posterior cell. I am not sure till the male is examined, that these differences are specific. The very marked difference in the color of the legs will, however, justify the varietal name.

Anthrax n. sp.

This species, represented by a single specimen from Panamint Valley, I can not identify with any described species. In Coquillett's most recent synopsis, it is brought straight to *A. scitula*, from which it differs, however, in important particulars, aside from the markings of the wings, the figure of which, herewith given, will permit the recognition of the species.

Anthrax fenestratoides Coquillett, Trans. Amer. Ent. Soc. xix, 185, 1892.

A single specimen, agreeing well with the description, from Panamint Valley, Calif.

Anthrax (Stonyx) sodom, n. sp.

Female.—Black, the legs chiefly yellowish. Face produced conically; clothed, like the front, with black pile slightly intermixed with white tomentum. Proboscis not projecting beyond the epistoma. Style of antennæ about twice the length of the bulbous portion. Occiput with yellowish tomentum. Mesonotum clothed with white tomentum and sparse, erect, black hairs. Abdomen white tomentose, with a moderate amount of black tomentum, and with sparse, erect, long black hairs; the margins of the abdomen with black and white pile. Base of femora somewhat blackish; front tibiæ without spinules; front ungues small, the pulvilli apparently wanting. Wings with brown markings, as in the figure. Length 7^{mm}.

One specimen, Death Valley, Calif., April, 1891 (Koebele).

Anthrax n. sp.

A single specimen, from Panamint Valley, Calif., seems to belong to a new species. It is taken to be *A.* (*Dipalta*) *serpentina* in Coquillett's table, from which it differs decidedly. The figure herewith given will enable it to be recognized.

Aphœbantus vittatus Coquillett, Can. Entom. May, 1886.

A single specimen from Panamint Valley, Calif., April 21 (Koebele), seems to be this, though the thorax and abdomen do not have a very "vittate" appearance.

Argyramœba daphne Osten Sacken, Biol. Centr. Amer. Diptera, i, 104, pl. 11, f. 6, 1886.—Mexico.

One male, from Panamint Valley, Calif. It agrees so closely with the description and figure of this species that I believe the determination very probable. It has, however, *three* submarginal cells in each wing, a fact which sustains Coquillett's objections to the acceptation of *Stonyx* and *Dipalta*.

Triplasius novus n. sp.

Male.—Head narrower than the thorax. Eyes broadly contiguous, the facets markedly larger above, but without a dividing line, the posterior orbits with a *distinct incision.* Antennæ inserted close together, slender, second joint short, about as long as broad, and about one-third the length of first joint; third joint longer than the first two together, a little thickened at the base, slender on the distal half, terminating in a minute bristle. Frontal triangle with a median impression; triangle and face clothed with abundant pile. Oral opening large, its upper margin nearly opposite the middle of the eyes. Proboscis long, palpi slender. Thorax and abdomen clothed with thick, bushy pile. Abdomen a little longer than the thorax and abdomen together. Legs not strong; ungues gently curved; pulvilli about half of the length of the claws, distinct. Three marginal cells present, the neuration otherwise as in *Bombylius*. Front light-grayish pollinose, clothed with black hairs in the middle. First two joints of the antennæ with abundant black hair. Face with abundant light-yellowish hair, intermixed with black; the uppermost part of the face in ground-color is black; along the oral margin, reaching the eyes, broadly yellow. Cheeks black, grayish pollinose. Antennæ, palpi, and proboscis black. Pile of the occiput light yellowish or white. Thorax and scutellum opaque black, but almost wholly obscured by the long and abundant light yellow or white pile. Abdomen with long and abundant light yellowish or white pile; the sides of the second segment and the terminal segment with bushy, black hair. Legs black. Wings dark brown, more yellowish along the costa, and lighter colored distally. Length, 11^{mm}.

One specimen, Panamint Valley, Calif., April, 1891. The species is in all respects a *Bombylius* with three submarginal cells.

Comastes sackeni n. sp.

Female.—Differs from *C. robustus* in the smaller size, the presence of black hairs on the face and thorax, the wholly black scutellum, which is without bristles on its margin, in the abdomen being rather uniformly clothed with shorter white pile, intermixed with numerous long black hairs, and in the greater infuscation of the basal portion of the wings. The femora and tibiæ are black. Length, 9^{mm}.

One specimen, Argus Mountains, Calif., May, 1892.

Geron, n. sp.

A single, injured specimen, agreeing somewhat with specimens of *G. albidipennis*, but apparently different. Death Valley, Calif., May.

Lordotus sororculus n. sp.

Deep black, shining. Face, first two joints of the antennæ and the front clothed wholly with deep black pile. First antennal joint about half of the length of the slender third joint, the second joint but little longer than wide. Pile of the occiput, yellowish gray; that of the mesonotum and scutellum of the same color, abundant; some black pile on the pectus. Scutellum convex, without impression or groove. Knob of the halteres, yellow. Abdomen, both above and below, with long, nearly white pile. Legs black, with light-yellowish tomentum and black pile. Wings, pure hyaline. Length, 8^{mm}.

Two specimens, Coso Valley, May 21, and Kern County, Calif.

Melanostoma n. sp.

A single male specimen from Argus Mountains, Calif., May, 1891, evidently belongs to an undescribed species. It is nearest related to *M. cœrulescens* Will., but has the abdomen oval and elongate.

Ocyptamus abbreviata Loew. Williston, etc.

A single specimen of this widely distributed insect from Panamint Valley, Calif., April, 1891.

Pipunculus aridus n. sp.

Male.—Front and face black, with silvery pubescence. Antennæ black; third joint silvery on the lower part, produced below into a spinous point. Thorax black, dorsum a little shining, faintly brownish dusted on the disk. Abdomen greenish black, shining. Legs black; the immediate tip of the femora, the base of the tibiæ, and all the tarsi, save their tip yellow. Hind femora without bristles below. Wings hyaline; last section of the fourth vein sinuous, the three outer sections of the same vein of nearly equal length. Small cross vein much beyond the tip of the auxiliary vein. Length 3^{mm}.

One specimen, Argus Mountain, California, April, 1891. Is most nearly allied to *P. flavitarsis* Will., but differs in the color of the abdomen, and the more produced third joint of the antennæ.

Blepharopeza adusta Loew. Centur. x, 67.

A single specimen from Sonoma County, Calif. (Riley), agreeing well with the description, save that all the tibiæ are reddish.

Prospherysa similis n. sp.

Male.—Front somewhat narrowed behind; frontal stripe dark brown, on each side a single row of bristles descending below the base of the third antennal joint. Sides of the face and the cheeks wholly without bristles. Antennæ black; third joint four or five times the length of the second joint, not reaching the vibrissæ; arista thickened to about the middle. Face and sides of the front yellowish gray, a darker spot on the lower part of the cheeks. Palpi yellow, thorax black, lightly dusted, with three linear, darker stripes, scarcely visible behind. Tip of scutellum red, with four marginal bristles on each side, a small, medium, decussate pair and two small, subdiscal ones. Abdomen somewhat elongate; first segment only a little shorter than the second; all the segments marmorate with white; first and second segments each with a pair of marginal bristles, the third segment with six before the hind margin, the fourth segment with a subdiscal pair and numerous ones near the margin; hypopygium, red. Thorax, abdomen, and legs clothed with long and abundant black hair. Legs, deep black; pulvilli and claws elongate, the former light yellow, the latter yellowish; front tibiæ with a row of short bristles on the outer side; middle tibiæ with two or three median stout bristles; hind tibiæ with numerous bristles, of which two are longer than the rest. Tegulæ, white. Wings, grayish hyaline; the small cross vein situated a little before the middle of the discal cell. Length 13^{mm}.

Female.—Front broader, about one-third of the width of the head; a pair of orbital bristles present; hair of thorax and abdomen less abundant, and that of the abdomen more recumbent and bristly; claws and pulvilli not elongate. Length, 10^{mm}.

Two specimens, Sonoma County, Calif. The female bears the label "Clisiocampa," sp. The species is nearest allied to *P. apicalis* v. d. Wulp, where it is clearly brought by Wulp's table. It will be distinguished from *P. promiscua* Towns., as also *P. websteri* Towns., by the bare eyes, as well as other characters.

Prospherysa sp.

A single male specimen from Alameda County, Calif. (Riley), seems to agree well with *P. plagiodes* v. d. Wulp in its neurational characters, but has the third vein bristly for a short distance only.

Melanodexia gen. nov.

Eyes of male separated above by the ocellar prominence; front in the female very broad. Bristles of the front numerous and hair-like in the male; in the female shorter, fewer, and stouter; not descending below the base of the antennæ. Eyes bare. Second joint of the antennæ somewhat swollen, the third joint not three times the length of the second; arista short plumose. Sides of face and the cheeks hairy. Vibrissal ridges nearly parallel; vibrissæ slender, situated a considerable distance above the oral margin, the epistoma not projecting. Bottom of the facial groove only gently convex. Width of the cheeks less than one-half of the greater diameter of the eyes. Proboscis short, palpi slender. Thorax and scutellum with well developed bristles. Abdomen short-conical, without distinct macrochætæ, save on the distal part; in the male, with abundant erect hair on the anterior segments, and thin bristles posteriorly; in the female, with short recumbent bristles anteriorly, and longer bristles posteriorly. Third longitudinal vein strongly convex in front, terminating very near the tip of the wing; antepenultimate section of the fourth vein fully twice the length of the penultimate section, the latter joining the ultimate section in an angle, which may be slightly rounded in the female. Legs not elongate, the bristles of ordinary size; hind tibiæ not ciliate; pulvilli and ungues small in both sexes.

This genus is nearest allied to *Morinia* and *Pseudomorinia*, but differs in the small claws of the male, the higher position of the vibrissæ, the situation of the posterior cross-vein, the closed first posterior cell, and the absence of discal and marginal bristles on the anterior abdominal segment.

Melanodexia tristis n. sp.

Male.—Wholly black, shining, with black bristles and hair. Tegulæ blackish; pulvilli yellow. Frontal stripe opaque, very narrow above, separating the eyes; three or four times as wide below; the narrow lunula shining. Hair of the lower part of the cheeks long. Thorax and scutellum with long bristles and moderately abundant erect hair. First two segments of the abdomen with abundant erect hair, posteriorly the abdomen is, for the greater part, clothed with numerous, erect, slender bristles. Wings tinged with blackish, especially along the veins. Length, 6mm.

Female.—Frontal stripe very broad, on each side with a row of short bristles; orbital and ocellar bristles present. Thorax and abdomen not hairy, but nearly bare, with short, recumbent bristles instead. Length, 7mm.

One male, Southern California (Baron), and one female, Monterey County, Calif. (Riley).

Lispa tentaculata Degeer, Ins. vi, 42, 15, 1776 (Musca) Latreille, Gen. Crust. et Ins. iv, 347, 1809; Fallen, Dipt. Suec. Musc. 93, i, 1820; Meigen, Syst. Beschr. v, 226, 1826; Macquart, Hist. Nat. Dipt. ii, 314, 1835; Zetterstedt, Dipt. Scand. v, 1796, 1846; Walker, Ins. Dipt. Brit. ii, 147, 1853; Schiner, Fauna Austr. i, 660, 1862; Rondani, Dipt. Ital. Prodr. vi, 289, 1877; v. d. Wulp, Tijdschr. v. Ent. xi, 1868, pl. ii, f. 6; Kowarz, Wien. Ent. Zeit. xi, 000, 1892.

Habitat.—All Europe (Kowarz), New England, Michigan, South Dakota, California.

Two specimens, Panamint Valley, April, 1892. The species is especially characterized by the slender spur-like projection of the front metatarsi in the male.

Euxesta spoliata n. sp.

Female.—Shining, somewhat metallic green. Front, red or reddish yellow, with moderately coarse hairs. Antennæ, reddish or brownish yellow, third joint rounded. Face, reddish yellow, of a little lighter color than the front, not pollinose. Thorax, bright green, somewhat shining, thinly pruinose. Abdomen, black or pitchy black, the first two segments red or yellowish. Legs, yellowish or brownish red, the distal joints of all the tarsi blackish. Halteres, light yellow. Wings, whitish hyaline, with light-colored veins, except in the dark spots, where they are blackish; the costal and subcostal cells are blackish throughout, encroaching somewhat on the marginal cell. The large blackish spot at the tip begins on the costa a little beyond the middle of the antepenultimate section and reaches nearly to the fourth vein; the last section of the fourth vein converges markedly toward the third. Length, 4mm.

Three specimens, Death Valley and Panamint Mountains, Calif.

Ephydra tarsata n. sp.

Front shining greenish black, with two pairs of proclinate ocellar bristles; about three pairs of reclinate bristles below, a row along the orbit, directed inward, and a vertical bristle to the inner side of the row, directed inward. Antennæ black; a small bristle on the upper side of the second joint; arista very short, pubescent on the much thickened basal portion. Face showing somewhat greenish beneath the grayish pruinosity; hair long and black. Thorax black, with a thin gray pruinosity; the dorsum faintly striate. Abdomen black, olivaceous grayish pollinose, not shining; hypopygium small, mostly concealed. Legs black, grayish or greenish pruinose; front metatarsi in the male thickened and longer than the following three joints together; in the female, simple but elongate. Wings grayish, hyaline; small cross vein opposite the tip of the first longitudinal vein; posterior cross vein oblique. Length, 5–6^{mm}.

Two specimens, Owens Valley, May 21, 1891.

This species will be readily recognized by the small hypopygium of the male, and the thickened front metatarsus in the same sex, together with the nearly bare arista.

Notiphila decoris n. sp.

Female.—Front gray or brownish gray, with two black stripes, separated by the triangular, brownish ocellar triangle; the median, anteriorly directed pair of bristles well developed. Antennæ and palpi black. Face opaque, light golden yellow. Dorsum of thorax and scutellum opaque yellowish brown, somewhat grayish anteriorly; the stripes only feebly indicated. Pleuræ more grayish-yellow below, with two shining black spots. Abdomen chiefly dark coffee-brown, with the posterior part and a median stripe on each segment gray. Legs black, the base of the front metatarsi and the first three joints of the four posterior tarsi reddish yellow. Wings cinereous. Length, 3½^{mm}.

One specimen, Panamint Valley, Calif., April.

Pelomyia gen. nov. *Ephydridarum.*

Third joint of antennæ rounded, second joint not unguiculated; arista long, very finely pubescent, nearly bare. Eyes wholly bare. Face of only moderate breadth, moderately convex. Cheeks moderately broad. Front moderately broad with well-developed bristles. Clypeus not projecting. Thorax with four rows of bristles, extending to the anterior part. Middle tibiæ without bristles on the outer side.

The genus seems nearest related to *Pelina*, from which it differs in the retracted clypeus, the bristles of the anterior part of the thorax, etc. The eyes are bare under the highest magnification. The neuration does not differ from *Notiphila*, etc.

Pelomyia occidentalis n. sp.

Male, female.—Vertical triangle large, yellowish gray; front, below the triangle, opaque yellow, the orbital margins narrowly white, pollinose; vertical triangle, with two proclinate bristles; a row of three bristles on the orbital margin. Antennæ brownish black, the under side of the third joint yellowish; second joint with a weak bristle at its extremity. Face yellow, not broad, somewhat whitish, pollinose; on either side with a few short, weak bristles. Dorsum of thorax brownish gray, with three slender brown stripes. Scutellum large, bare, with two pairs of bristles, the intermediate pair near the apex and large, the outer pair small. Abdomen black, with a brownish pubescence, opaque, the small hypopygium shining black; in shape elongate oval; sixth and seventh segments of the female very short. Legs black, or somewhat luteous, rather slender; femora with some short bristles. Wings nearly hyaline. Length, 2½^{mm}. Two specimens, Monterey, Calif.

Scarcely any attention has hitherto been given to the Borboridæ of America, a group of considerable interest, as including several of the few wingless forms of Diptera. I have examined about twenty species of the family from the United States and West Indies, nearly all of which are yet undescribed. I give here a table of genera based upon these species, and will shortly publish descriptions of them:

North American genera of Borboridæ:

1. Wingless species .... APTERIN[illegible]
   Wings fully developed ....

2. Fourth and fifth veins of the wings incomplete beyond the discal cell, not reaching the border ....LIMOSINA
   Fourth vein, at least, fully developed and reaching the border 3
3. Scutellum with well-developed bristles; the fifth vein incomplete beyond the discal cell..BORBORUS
   Scutellum without bristles; fifth vein complete ....SPHÆROCERA

Borborus, sp.:

Two specimens, Argus Mountains, which seem to belong to a new species.

Limosina aldrichi n. sp.

Male.—Black, but little shining, nearly bare. Face somewhat whitish. Front, but little shining in the middle. Antennæ black, arista long, distinctly pubescent. Thorax shining. Scutellum flattened, bare, with six bristles, the pair near the apex much larger than the ones toward the base. Abdomen opaque, somewhat pruinose. Legs black, the tibiæ and tarsi more or less dark luteous; hind metatarsi only a little dilated, and but little shorter than the following joint. Wings nearly hyaline; the third vein ends beyond the small cross-vein, gradually and nearly uniformly curved forwards; the tip of the second is nearly midway between the terminations of the first and third veins, the latter ending near the tip of the wing; fourth vein beyond the discal cell faintly indicated. Hind cross-vein rectangular to the fourth vein. Length, 3mm.

One specimen, Argus Mountains, April, 1891.

Apterina polita sp. nov.

Female.—Very small, shining black, without wings and apparently without halteres. Scutellum large, flattened, trapezoidal, with four well-developed bristles. Face excavated in profile; oral margin on either side with a conspicuous bristle. Cheeks moderately broad. Clypeus retracted into the oral cavity. Antennæ short, third joint rounded, hairy, with a long, pubescent arista. Eyes bare. Front broad, with a row of orbital, proclinate bristles. Thorax with bristles. Abdomen broadly oval, depressed, with six visible segments, the second, third, and fourth of nearly equal length. Legs slender, with bristles, the middle tibiæ, at least, with a preapical bristle; first joint of the hind metatarsi short, and dilated. Front opaque, with a shining median stripe of elongated triangle; face and cheeks whitish dusted. Dorsum of thorax, scutellum and abdomen shining, the hair very short and sparse. Tip of femora, base of tibiæ, and the tarsi, save the tip, yellowish. Length $1\frac{1}{4}$mm.

Three specimens, Panamint Valley, April, 1891.

Apterina is subordinated to *Borborus* by Schiner, and he may be right in doing so. The present species is in all respects a wingless *Limosina*, but that genus has no tangible differences from *Borborus* save such as are found in the neuration. A mere excrescence, of a yellowish color, is all there is to be seen of the wings. I therefore locate the species, provisionally, at least, in Macquart's genus.

NOTE.—In addition to the Diptera reported upon above by Dr. Williston, the collection contains 7 species easily named which were not sent to him, nor was it thought worth while to introduce these few names into the tabulated list which precedes. They are added here, however, for the purpose of completing the report.—C. V. R.

Tabanus punctifer O. S.........................4 ex., Panamint Valley and Death Valley.
Pantarbes capito O. S.........................1 ex., Argus Mountains.
Triodites mus O. S.............................1 ex., Coso Valley.
Lordotus diversus Coq.........................5 ex., Panamint Valley and Death Valley.
Ploas fenestrata O. S.........................3 ex., Death Valley.
Platychirus peltatus Meig.....................1 ex., Argus Mountains.
Bibio hirtus Loew.............................1 ex., Santa Cruz Mountains.

HEMIPTERA, HETEROPTERA OF THE DEATH VALLEY EXPEDITION.

By P. R. Uhler.

COREIDÆ.

Harmostes propinquus Dist., Biol. Cent. Amer. Hemipt., p. 168, No. 7; pl. xv., fig. 19.

A damaged specimen, of somewhat larger size than usual, was secured on the Argus Mountains in May, 1891.

BERYTINÆ.

Pronotacantha n. gen.

Form of *Parajalysus* Distant, but with long, erect, remote spines on all sides of the pronotum, those of the front border directed obliquely forwards, those of the sides pointing outwards, the posterior pair pointing backwards, and the single one on each humerus curved at tip, posterior portion of the pronotum convex, very much elevated behind, emarginated for the base of the corium. Scutellum small, flat, armed with a long slender spine. Epipleura with a short tooth beneath the base of the wing-cover. Antennæ and legs with the usual knobs at end of joints. Wing-covers flat, very much wider and longer than the abdomen, nearly spindle-shaped in outline, almost membranous and translucent throughout, the costal areole wide, crossed by a coarse diagonal vein, followed by a longer areole which is also bounded at tip by a diagonal vein which sends off a thinner vein to curve outward and bound a narrow, cuneus-like areole running to the tip of the wing-cover, behind this, extending inwardly, are four long areoles which constitute the end of the wing-cover. Abdomen a little swollen at base, narrow behind. Middle coxæ placed far back from the anterior pair, but not remote from the posterior coxæ.

P. annulata n. sp.

Pale fulvous, with the head, front, and back of the pronotum polished black. Head short, subglobose, with the tylus forming a prominent vertical ridge, bounded by swollen cheeks; eyes prominent, brown; rostrum reaching to behind the middle coxæ, dark piceous, paler on the middle and beneath. Antennæ long and slender, annulated with black, the basal joint longer than the head and pronotum united, a little thickened at tip, second joint about one-half as long as the basal, the third a little longer, the fourth joint black, pale at tip, very short and thick, fusiform but acute at both ends. Pronotum stout, broad and tumid behind, black, polished, with a broad yellow band which narrows below and extends upon the sternum, spines chiefly yellow, those of the base longer. Scutellum narrow, testaceous, armed with a long, erect, yellow spine. Legs slender, testaceous, banded with black, the femora clavate and wax-yellow at tip. Wing-covers testaceo-hyaline, almost membranous throughout, the veins delicate and a little deeper colored than the integument, those of the corium thick, brown, especially the costal one, the corium unevenly punctate, very short, triangular at tip, with the costal rib carried far beyond its tip; the membrane is much longer than the corium and extending well along its inner border, and has a series of four long and wide areoles. The cubital area is long, narrow, oblique at tip, and from it is continued a much narrower apical areolar extension, and these areas are all punctate and minutely bristly along the veins. Abdomen polished, somewhat piceous at base and tip, tinged with rufo-ferrugineous on the sides superiorly, acutely narrowing towards the tip in the male.

Length to end of abdomen, 4 mm; width of pronotum, $\frac{3}{4}$ mm. One specimen, a male, was taken on the Argus Mountains in April. This specimen has the greater portion of the veins of hemelytra pale brown. Several other specimens from different parts of Arizona have been submitted to me for examination.

This genus comes near to *Metacanthus*, but it differs widely therefrom in the venation of the wing covers. It has also close affinities with *Parajalysus* Dist., from which it differs also in venation, armature, etc.

Acanthophysa n. gen.

Apparently related to *Hoplinus* Stål., but quite abnormal by reason of the broad fusiform figure, emphasized by the upwardly inflated hemelytra, which appears semicoriaceous throughout, terminate in an acute point behind, and have the veins arranged longitudinally like ridges, and which carry series of remote, long, erect spines. Head acutely produced, conforming to the front of the pronotum, and armed each side with a series of long, anteriorly directed, almost procumbent, sharp spines. Rostrum reaching the posterior coxæ, the basal joint thick and long; antennæ long and slender, the basal joint as long as the two following united, clavate at tip, the apical joint short, fusiform, acute at tip. Pronotum subcampanuliform, flattened above, encircled and set with long, oblique spines pointing outward, the middle with a strong transverse section. Scutellum triangular, acute. Hemelytra with rows of long, remote spines on the veins, and fringed with a series on the costal and cubital border all the way to the tip; the discoidal vein closely forked, and the central areole narrow and long, acutely narrowed at tip and crossed by about three veinlets before the tip, veins minutely, remotely punctate. Legs long and slender, the femora clavate at tip, and the posterior ones shorter than the abdomen. Venter almost flat, slightly convex.

A. echinata n. sp.

Grayish white, with the legs and antennæ wax yellow, and the hemelytra marked with short, fuscous streaks on the coarse veins and a few irregular spots on the disk, bases of the spines mostly fuscous, and the head and pronotum a little fuscous in spaces; the apical joint of antennæ blackish. Head long and acute, yellowish, with a sharp spine above, and others each side, all projecting forward; rostrum yellowish; antennæ darker on the swollen tip of first joint. Pronotum moderately flat, having a dark band in front, the posterior lobe pale yellow, the basal margin almost truncated, with a short spine in the middle pointing backward, all the margins and the humeral angles armed with long, slanting spines, those of the anterior lobe longest and projecting over the head. Scutellum with the central carina and lateral raised margins ivory yellow. Legs banded with fuscous with the apex of the femora greatly swollen, piceous. Hemelytra with the spines chiefly white and directed obliquely outward and backward, the veins, especially on the disk and next the claws, interrupted with pale brown or fuscous membrane, forming an almost acuminate tip, having two approximate veinlets running throughout its length. Venter yellowish, spread with white, marked with interrupted raised longitudinal lines, a little sprinkled with fuscous, and the entire surface hispid with short bristly spines, the apex infuscated.

Length to tip of venter, $3\frac{1}{2}^{mm}$.; width of pronotum, $\frac{3}{4}^{mm}$.; width of hemelytra across the middle, $1\frac{1}{4}^{mm}$.

One specimen, a male, was secured at the Argus Mountains in April, and I have examined two other specimens which were collected near Los Angeles, Calif., by Mr. Coquillett. The costal rib is sharply raised, and is protracted to the very tip of the subcoriaceous corium; and the apexes of this corium are widely separated by a triangular interval.

This most remarkable insect might perhaps be confounded with the prickly seed vessel of some of the sand ticks or beggars' lice which grow in sandy places.

Although unquestionably a member of the family *Berytidæ*, it is the most aberrant form of this group as yet discovered, and it helps to set forth the principle that there is a wide divergence of composition in the adjustment of the parts of the wing-covers in this remarkable group.

LYGÆIDÆ.

Lygæosoma Feib.

L. solida n. sp.

Narrow and deep, gradually narrowing from the middle of corium to the front of pronotum; the surface dull, minutely grayish, pubescent all over, black, with the corium and humeral angles and a spot on the middle of the basal margin of pronotum dull red. Head broad, convex, appearing longer from the acutely projecting tylus, each side of which the cheeks are sunken toward the antennal lobes; antennæ stout, coated with minute gray pubescence; rostrum black, piceous, reaching to behind the middle coxæ. Pronotum longer than wide, almost flat, crossed next the middle by an indistinct ridge, humeral angles tubercular. Prosternum in front and margins of the pleural segments dull yellowish. Legs polished, black, hoary pubescent. Scutellum minutely pubescent, the carinate cross acute and pale at tip. Corium and clavus a little rough, closely pubescent, with the edge next the membrane a little dusky, the costal margin curved, and the membrane dusky black; tergum polished black, venter dull black, rendered a little gray by the hoary pubescence.

Length to tip of venter, $4\frac{1}{2}^{mm}$; width of base of pronotum, $1\frac{1}{2}^{mm}$.

Two specimens, a male and a female, of the brachypterous form were secured in Mariposa County, Calif.

The membrane has an obscure pale lunule on the middle, and a very narrow whitish outer border.

Lygæus Fab.

L. melanopleurus n. sp.

Form of *bistriangularis* Say, but having the pronotum a little shorter, more depressed behind the middle, and with the lateral margins a little sinuated. Color mainly dull black, rendered grayish by the close, whitish pubescence which invests both the upper and lower surface. Head stout, moderately wide, convex above, marked with a red dot next the middle of base, the front narrow, with the cheeks compressed from the antenniferous lobes downward; the rostrum piceous, black, reaching upon the posterior coxæ, antennæ black, thick, grayish, pubescent; pronotum a little wider than long, depressed, and with a few coarse, dragged punctures behind the anterior margin; callosities transverse, distinct, the surface behind them depressed, a little rough, and with a few coarse punctures; lateral margins moderately oblique, feebly sinuated before the middle, with the humeri a little raised into a longitudinal ridge, the posterior margin nearly straight and slenderly edged with yellow; scutellum a little rough, depressed behind the middle, with the tip carinate and acute. Hemelytra paler and more lead-colored than the thorax, with the costal border broadly yellowish red, the posterior border more slenderly yellow, the surface pubescent and remotely minutely punctate; membrane long, black, broadly bordered with white. Pectus black, hoary, pubescent, marked each side of line of legs with a row of pale spots. Legs black, pubescent. Venter reddish, black at tip, and with a broad blackish stripe on the side following the line of the stigmata.

Length to end of venter, $4\frac{1}{2}$ to 5^{mm}.; to tip of membrane, 6^{mm}.; width of base of pronotum, 2^{mm}.

Two specimens were obtained on the Panamint Mountains in April. It inhabits also Colorado.

Lygæosoma sp.

A specimen with robust figure and of the brachypterous form was collected in Mariposa County, Calif., but it is too greasy for description.

Pamera Say.

P. nitidula n. sp.

Dull blackish, with the head and thorax polished, chestnut brown, and the hemelytra pale testaceous, with a broad black band across the posterior part of the corium, an irregular spot near its base, and a spot at tip of cuneus, which runs back slenderly on the outer margin. Head long, subacute at tip, set with erect bristly hairs, transversely wrinkled; rostrum yellowish, slender, reaching behind the middle coxæ; antennæ pale yellow, slender, a little brown at points of articulation, the second joint as long as from the front of the eye to the pronotal stricture, the apical joint scarcely darker than the others, equally as long as the second, first and third much shorter, subequal in length. Pronotum highly polished, a little darker across the base, the anterior lobe globosely convex, much narrower than the basal lobe, having a constriction and collum in front, the latter being punctate and a little produced behind, bounded by a deeply incised line, the surface spread with some bristly hairs; posterior lobe depressed, about as wide as the length of the anterior lobe, coarsely remotely punctate, with the humeral angles callous and elevated. Legs pale yellow, the anterior femora very stout, pale chestnut brown, with the knees and teeth darker, the anterior tibiæ strongly bent, pectoral and pleural areas polished roughly and coarsely punctate and clothed with stiff pale hairs. Scutellum piceous, remotely punctate, sparingly pubescent, ridged from the middle to the tip, and with the tip pale and acute. Corium pale yellowish testaceous, darker at base, whitish at tip and on the cuneus, remotely punctate with brown in longitudinal lines, the embolium a little dusky and punctate in the crease, membrane dusky excepting the outer border, with pale veins. Venter pale reddish chestnut, dusky at base, the female with a sickle-shaped callosity running backward from the base.

Length to tip of venter 6mm, to end of membrane 6½mm, width of base of pronotum 1½mm.

A single specimen (♀) was obtained in the Argus Mountains, Calif., April. I have also examined two others from Texas and New Mexico. Only females have thus far been sent to me for examination.

Crophius Stål.

C. disconotus Say. Heteropt. New Harm., p. 14, No. 6.

One specimen was collected on the Argus Mountains in May. This is *Lygæus discnotus* Say, the specific name of which is a misprint for *disconotus*, and would have been more correctly *disconotatus*.

TINGITIDÆ.

Gargaphia Stål.

G. opacula n. sp.

Oblong, ovate, with the head, breast, abdomen, basal and last joint of antennæ and base of second joint black. Head produced in front, pale beneath, the rostrum extending to the middle coxæ, having the bucculæ white and continuous, with the white raised border which bounds the whole length of the mesosternum on its sides. Pronotum tri-carinate, convex, woolly over most of the surface and sides. The short anteriorly blunt and twice-tufted bulla stands next behind the head, the surface yellowish white, with a narrow reflexed border along the curved lateral margin, the scutellum narrow and less depressed than usual; also whitish, pubescent. Legs pale rufo-testaceous, slender. Wing-covers white, with the veins a little tinged with fuscous near the tip, the exterior margin bluntly curved, regularly curved at tip, the areoles small, unusually regular in size, a double series of them occupying the costal area, but tapering off to a single series at tip, the clavus opaque, coriaceous, coarsely punctate, minutely pubescent in common with the disk of corium. Beneath dull black, minutely pubescent.

Length to end of abdomen, 2¼ mm.; to tip of hemelytra, 3mm.; width of pronotum, 1 mm.

Only a single specimen of this peculiar species was secured. It was taken on the Argus Mountains in April. The prominent convexity of the pronotum with its fur-like covering of hair and narrow pronotum will serve to quickly distinguish this species from the others thus far described.

Monanthia Fab.

M. labeculata n. sp.

Form similar to that of M. *nassata* Puton, but with a shorter pronotum and smaller meshes to the hemelytra, color fuscogriseus. Head short, convex, bronze-black, closely punctate, convex, the tylus vertical, bucculæ large, lamelliform, whitish, coarsely pitted in common with the gula; antennæ rufous, the basal and apical joints and the base of the second joint black; rostrum piceous, reaching to between the middle coxæ. Pronotum a little darker than the hemelytra, convex, prominently lobate each side, the lobes long-oval, occupying the whole length, and divaricating posteriorly, the sunken longitudinal between them occupied by a piceous carina which is continued back to the tip of the scutellum, the surface covered with coarse sunken punctures, with short, yellowish hairs in the spaces, collum whitish, prominent in the middle, granulated and blackish piceous behind; humeri strongly convex, blackish and granulated at the faintly carinated lateral margin; beneath black, the propleuræ piceous, coarsely punctate, but the tumid pieces of the meso— and metasternum smooth. Scutellum grayish testaceous, with the baso-lateral divaricating carinæ short, piceous, granulate, confined to the outer angles, the medial carina pale testaceous except at base, the surface granulate in lines, a little punctate and minutely, remotely pubescent. Corium pale-grayish testaceous, a little tinged with bronze, remotely punctate and pubescent, studded with piceous granules, and with the discoidal vein especially prominent; blackish, bullate and uneven, the cells of the membrane usually with dusky veins, and the cross veinlets of the costal border, including those of the membrane, black, the coarse vein bordering the corium often piceous black. Venter dull black, obsoletely rostrate.

Length to tip of wing-covers, 3 ^{mm}; width of pronotum, 1 ^{mm}. Nine specimens were taken from *Pinus monophylla*, on the Argus mountains in May, 1891.

The species bears some resemblance to others of this genus common in Brazil and Central America.

Leptoypha Stål.

L. mutica Say. *Tingis mutica* Leconte Ed. Say's Writings, vol. i, p. 349.

A dozen or more specimens of this common insect were collected on the Argus mountains in April and May. I find no difference to separate these specimens from those of Texas and other parts of the United States.

CAPSIDÆ.

Hoplomachus Fieb.

H. consors n. sp.

Robust, tapering anteriorly, cinereous tinged with olive, clothed with long pile on the head and fore part of pronotum, and with shorter pubescence on the remainder of the body. Head long, conical, acute as seen from above, indented each side near the eyes, with a pale yellow or orange line on the carinate middle, running back over the pronotum and continuing to the tip of the scutellum, tylus almost vertical, bounded by deeply cut sutures, covered with pale gray pile, the middle cheeks small, prominent, black, sharply defined; rostrum pale piceous, darker and acute at tip, reaching behind the posterior coxæ, the basal joint stout, inflated at tip, longer than the throat; eyes brown, with a bullate black space beneath them, and with one or two black raised dots near the base of tylus; antennæ rather slender, reaching behind the tip of the scutellum, the basal joint and lobe piceous black, the second joint as long as from the front of eye to the base of pronotum, pale olive, darker on the ends, the two following darker, short, more slender, pronotum trapeziform, convex behind a little scabrous over most of the surface, the lateral margins oblique, sharp edged, a line of obsolete dark spots occurs across the base, in front of this each side is an oblique mark, and farther forward is a larger transverse spot each side; scutellum darker each side of basal portion; pectus dark in the depressions, the pleural pieces coarsely punctate, the prosternum, including the xyphus, pale, but blackish at base; legs dusky testaceous, with the nails, tips of tarsi and spines piceous; hemelytra wide, almost translucent, closely hoary pubescent, the costal margin broadly curved, the disk and claws dusky olive, membrane pale dusky olive, venter dark olive with a fuscous tinge, finely pale pubescent, with the genital pieces paler.

Length to end of abdomen, 4^{mm}; to tip of membrane, 4$\frac{1}{2}^{mm}$; width of base of pronotum, 1$\frac{1}{2}^{mm}$.

One specimen was taken on the Argus Mountains in May. The species occurs in the vicinity of Los Angeles and in other parts of southern California.

Some five or six other new species of genera related to *Lygus*, *Macrotylus*, and *Psallus*, belong to this collection, but they are not in condition for description.

ANTHOCORIDÆ.

Anthocoris Fall.

A. musculus Say. Heteropt. New Harmony, p. 32; No. 6.

One specimen was secured on the Argus Mountains in April.

SALDIDÆ.

Salda Fab.

1. **S. interstitialis** Say. Journ. Philada. Acad., vol, iv; p. 324; No. 1.

Two specimens were secured in the Panamint and Argus mountains in April. They belong to two varieties with the white spots not widely distributed.

2. **S. explanata**, new sp.

In form similar to *S. brachynota* Fieb,, of Europe. Deep black, dull, covered with minute golden pubescence. The head but little wider than the front of the pronotum, and the eyes moderately prominent, the clypeus margined each side and the tylus entirely testaceous; antennæ stout, black, white on the outside of the basal joint. Pronotum short, transversely wrinkled behind, the base deeply sinuated, the lateral margins oblique and a little curved, the submargin broadly, deeply depressed, remotely punctate, with the edge a little recurved, the humeral angles with the button-like callosity near the border; callosities transversely prominent, with a sunken dot in the middle between them; pleural depression coarsely and remotely punctate. Tip of femora, the tibiæ excepting the base and tip, and the tarsi excepting the tip, pale testaceous. Hemelytra obsoletely and minutely punctate, remotely pubescent, marked with whitish oblong flecks, an obsolete pair being placed near the tip of the clavus, a few minute ones from near the base to behind the middle, an angular spot next the middle of the posterior margin and a more distinct white dot exterior to this; the membrane has four long, narrow, pale areoles marked with the ordinary smoky oblong spots, and the posterior border is also smoke-brown with a white dot at the inner angle. Venter dull black, minutely pubescent, with the sixth segment of the female broadly and unevenly bordered behind with white.

Length to tip of membrane, 4$\frac{1}{2}$ to 5^{mm}; width of base of pronotum, 1$\frac{1}{2}$ to 3^{mm}.

This species occurs in various regions west of the Rocky Mountains. I have examined specimens taken in Nevada, Olympia, in Washington State, various parts of Utah, and California. A pair of specimens in the present collection were secured in the Panamint and Argus mountains in the month of April.

DESCRIPTIONS OF NEW SPECIES OF ORTHOPTERA FROM THE DEATH VALLEY EXPEDITION.

By Lawrence Bruner.

Ameles sp.

Possibly new, but the specimen is in too bad a condition to be described, it having been broken while en route in the mail, besides being immature. This same insect has been examined by me on several former occasions. It appears to be quite widely distributed in the arid and semiarid regions of the Southwest, as I have it from various points in New Mexico, Arizona, and California. I have also seen specimens from southern Idaho and middle Nevada.

Heterogamia sp.

Like the preceding, this insect is also probably undescribed. It is a female specimen, and can not well be characterized now. This form seems to be not at all rare in some portions of Arizona and southwestern United States, and also occurs in portions of old Mexico.

Tridactylus sp.

The collection contains a specimen of an apparently undescribed species of this genus, but until I have had a little more time to study these peculiar little crickets, I would prefer not to name it. Other specimens of the genus have been taken along the Colorado River during the past summer, and have just lately come to my notice.

Nemobius sp.

This insect may also be new. I have seen specimens very similar to this from the vicinity of Los Angeles, Calif., and if represented in the collection, I can not at present find it. I will not try to describe the species from the single male before me.

Encoptolophus pallidus n. sp.

General color dull yellowish brown, varied with faint dusky markings common to the representatives of the genus. Head moderately large, a little wider than front edge of pronotum. Vertex about as wide as the eyes, depressed in front where the lateral carinæ meet in less than a right angle, these carinæ bowed and approaching slightly behind, but fading away into the sides of the occiput along the hind margin of the eyes; the sulcus quite deep and provided with a well-defined central carina posteriorly; frontal costa quite prominent above, of nearly equal width throughout, but slightly sulcate at the ocellus and below (♀), or more deeply grooved throughout (♂); antennæ not quite as long (♀) as head and pronotum combined, or slightly surpassing the latter (♂), a little enlarged and slightly flattened toward their tips in the male; pronotum small, with the sides nearly parallel when seen from above, the lateral carinæ well defined, but interrupted a little in advance of the middle carina, not prominent, equal throughout, cut a little in advance of the middle by last transverse sulcus, the hind border a little obtuse-angled. Tegmina and wings of about equal length, surpassing the tip of the abdomen in both sexes. Posterior femora not much inflated basally, but passing the tip of abdomen slightly in both sexes.

Color.—Male and female dull dry-grass color, marked faintly back of the eyes, along sides of pronotum, on front edge of tegmina and on posterior femora with the characteristic fuscous blotches and bands. Posterior wings hyaline, with the tips apparently but little darker than the disk and base. Hind tibiæ pale glaucous with basal third pale.

Length of body, ♂, 18 mm., ♀, 24 mm.; of attennæ, ♂, 7 mm., ♀, 6.5 mm.; of pronotum, ♂, 3.75 mm., ♀, 4.7 mm.; of tegmina, ♂, 15.5 mm., ♀, 19 mm.; of hind femora, ♂, 10.5 mm., ♀, 13 mm.

Habitat.—Panamint Valley, Cal., April 6, 1891.

Scirtettica occidentalis n. sp.

The collection also contains a single female specimen of locust which has the general appearance at first glance of a *Trachyrrhachys*, but upon closer examination proves to be more nearly related to *Scirtettica marmorata* Uhl. of the New England coast.

Head, with the occiput rugulose, rather small and deeply set into the front edge of the pronotum, which latter is also quite rough; vertex between the eyes a little narrower than their shortest diameter, deeply grooved and provided with a deep triangular pit in front, the lateral walls prominent and farthest apart at front edge of eyes, approaching posteriorly but not quite meeting; frontal costa deeply sulcate with the walls prominent, diverging below. Antennæ not quite reaching the posterior edge of the pronotum, filiform, but gently compressed. Pronotum short, about as broad as long, strongly compressed near the front above, the median carina prominent but not arched, once severed a little in advance of the middle by the last transverse impressed line; lateral carinæ obliterated in front, but prominent behind; posterior angle a right angle. Tegmina and wings extending slightly beyond the tips of the abdomen, the former rather narrow. Hind femora with the base a little inflated; hind tibiæ with the apical spines strong and longer than usual. Entire insect more or less thickly clothed with short whitish hairs.

General color, grayish brown mottled and specked with plain brown and dull black. Middle of sides of pronotum with a short oblique whitish blotch. Tegmina with a median and postbasal brown spot on costal edge, apical third and posterior half irregularly flecked with quadrate flecks of varying sizes. Wings with disk-like waxy yellow, crossed just beyond the middle by a dull, rather narrow fuscous band that sends a dark ray nearly to the base along the costal edge, apex hyaline with two or three small fuscous spots along the principal veins. Posterior femora crossed above by three blackish bands, the middle one showing on the outer face as a very oblique band, anteriorly with the basal half black, beyond this with a yellow and then a black band, the knees dusky; hind tibiæ yellowish, infuscated apically and provided with an obscure dusky annulus near the basal third.

Length of body, ♀, 20mm.; of antennæ, 6mm.; of pronotum, 4mm.; of tegmina, 19mm.; of hind femora, 12.25mm.

Habitat.—A single specimen from Argus Mountains, Calif., May, 1891.

This insect does not properly fall in this genus, but appears to approach the members belonging here more closely than it does any of the other forms known to me, and for that reason is placed here, for the present at least.

Dracotettix plutonius n. sp.

A smaller species than the *D. monstrosus*, with a much lower median pronotal carina and the vertex shorter and more depressed.

Vertex between the eyes about as wide (♂), or a little wider than the shortest diameter of the eyes, shallowly sulcate throughout and divided into longitudinal halves by a rather prominent median carina, most marked behind, the lateral edges raised so as to form low walls; frontal costa of nearly equal width throughout, quite prominent to just below the ocellus; below this point the face is perpendicular; antennæ short, heavy, slightly broadened and flattened near the base, bluntly pointed. Pronotum in front a little wider than the head, the dorsum somewhat flattened, with the lateral carinæ evenly divergent posteriorly, nearly as prominent as the median, which has its lobes rounded, anterior margin obtuse-angled, the posterior acute-angled. Tegmina and wings abbreviated, acute, the inner margins not quite touching in the female, and but very slightly overlapping in the male, reaching past the back edge of the third abdominal segment in the former and nearly to the base of the supra-anal plate in the latter. Prosternal spine quite large, rounded behind, straight or slightly concave in front and very bluntly pointed.

The general color of this insect is dull grayish brown, the lighter color inclining to testaceous in the female and whitish in the male. Face, pronotum and tegmina, with the hind femora streaked with white (♂) or dirty yellowish white (♀). Hind femora crossed above with three fuscous and three lighter bands, the inner face for the most part black. Hind tibiæ and tarsi reddish on inner edges, gray outside. Antennæ infuscated on apical half.

Length of body, ♂, 19^{mm}., ♀, 39^{mm}.; of antennæ, ♂, 6.5^{mm}.; ♀ 8^{mm}.; of vertex, ♂, 1.3^{mm}., ♀, 2.1^{mm}.; of pronotum, ♂, 8^{mm}., ♀, 12.30^{mm}.; of tegmina, ♂, 8.5^{mm}., ♀, 13^{mm}.; of hind femora, ♂, 10.75^{mm}., ♀, 15.2^{mm}.

Habitat.—Panamint Valley, April, and Argus Mountains, May, 1891.

Other representatives of the genus Dracotettix have been taken in Arizona, at Los Angeles, in Napa County, and at Gilroy, Calif. Among the material thus gathered at least three well-defined species are represented.

REPORT ON THE LAND AND FRESH-WATER SHELLS COLLECTED IN CALIFORNIA AND NEVADA BY THE DEATH VALLEY EXPEDITION, INCLUDING A FEW ADDITIONAL SPECIES OBTAINED BY DR. C. HART MERRIAM AND ASSISTANTS IN PARTS OF THE SOUTHWESTERN UNITED STATES.

By ROBT. E. C. STEARNS, Ph. D.,
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The present report treats of the land and fresh-water shells collected in 1891 by the several subdivisions of the Death Valley Expedition, in southern California and Nevada, between latitude 34° and latitude 38° N. The routes followed by several of these parties led them into regions previously unexplored by naturalists, and specimens were secured from numerous thermal and mineral springs in the arid deserts of the southern part of the Great Basin, within the Colorado drainage area. The most interesting forms obtained were the two species heretofore referred to *Tryonia*, until recently regarded as obsolescent or absolutely extinct, but which were found to be living, as elsewhere remarked. *Helix magdalenensis*, another interesting species described from examples collected in the Mexican State of Sonora in 1889–'90 by Mr. Bailey, of Dr. Merriam's Division of Biological Exploration, was detected by Fisher and Nelson several degrees of latitude farther to the north than the habitat of Bailey's original examples and at a very much higher altitude. This latter, by its presence at this northerly station, contributes to our previous knowledge and data bearing upon the relations between the geographical distribution of species and environmental conditions or influences; and two fresh water forms, not before known, were added to the molluscan fauna of the region traversed by the expedition.

In addition to the desert material, small collections were made in the High Sierra and other parts of California, and a few species are included from Arizona, New Mexico, and Texas, collected by Dr. C. Hart Merriam and assistants, while engaged in biological surveys of these regions under the Department of Agriculture. This latter material is important, as illustrating the geographical distribution of the species concerned.

LIST OF SHELLS.

Glandina decussata.
singleyana.
texasiana.
Streptostyla sololensis.
Limax campestris.
Patula striatella.
Helix (Arionta) magdalenensis.
coloradoënsis.
mormonum.
tudiculata.
cypreophila.
arrosa.
(Praticola) griseola.
berlandieriana.
(Mesodon) thyroides.
(Polygyra) texasiana.
bicruris.
Pupa (Vertigo) pentodon.
Bulimulus dealbatus.
alternatus.
serperastrus.
Succinea luteola.
oregonensis.
Limnæa caperata.
Limnæa nuttalliana.
humilis.
bulimoides.
Planorbis lentus.
liebmanni.
parvus
trivolvis.
Physa gyrina.
heterostropha.
Carinifex newberryi.
Amnicola micrococcus, sp. nov.
porata.
Tryonia clathrata.
Fluminicola fusca.
merriami.
fusca minor.
nuttalliana.
Helicina chrysocheila.
tropica.
Anodonta nuttalliana.
Unio anodontoides.
berlandieri.
Pisidium occidentale.

Class GASTROPODA.

Order PULMONATA.

Suborder *GEOPHILA*.

Glandina decussata Pfr.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123571), William Lloyd, March, 1891.

These examples, three in number, are not decussated, but are sculptured *only* by the longitudinal incremental lines; they have the usual glossy or semipolished surface characteristic of the group. These specimens are rather between the variety *singleyana* and the typical *decussata*, and indicate what is exhibited in other related forms, conspicuously in the shells of *G. truncata* of Florida, a considerable range of variation.

Glandina singleyana W. G. B.

? *G. decussata* Pfr., variety.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123572); also Monterey, Mexico (Mus. No. 123896), Feb., 1891, William Lloyd.

Two examples very close to *G. texasiana*, the principal difference being the curve and form of the termination of the columella. This seems to be the form that Mr. Binney refers to as collected by Prof. Wetherby in Bexar County, Tex., which he figures and calls *decussata* var. *singleyana* in Bull. Mus. Comp. Zoöl., Vol. XXII, No. 4, Pl. 1, Fig. 4, pp. 163–203.

Glandina texasiana Pfr.

Brownsville, Tex. (Mus. No. 123573), William Lloyd.

Two specimens. An ample series of the above, and the west Mexican *G. albersi* of the same author, might result in the reduction of the first to a synonymous position.

Streptostyla sololensis C. & F.

Victoria, Tamaulipas, Mexico (Mus. No. 123574), William Lloyd, March 30, 1891.

"In the Sierra." Though both examples are dead, and one broken, they are sufficient to validate the above determination. The species was described by Crosse and Fisher from Sololo (Guatemala) specimens.

Limax campestris Binney.

South Fork of Kern River, California (Mus. No. 123575), Vernon Bailey, July 8, 1891.

At an elevation of 2,700 feet; a single example. This may be Ingersoll's *L. montanus* or a variety thereof, which he obtained in Colorado. Ingersoll's *montanus* and *montanus* var. *castaneus*, Binney's *ingersolli* and Heynemann's *wienlandi* may be regarded, or at least strongly suspected, of close relationship to Binney's *campestris*, which latter may perhaps include Cooper's *L.* var. *occidentalis*.

Patula striatella Anth.

Kern River region, California (Mus. No. 123577), Vernon Bailey.

Numerous living examples at an altitude of 2,700 feet.

Helix (Arionta) magdalenensis Stearns.

Johnson Cañon, Panamint Mountains, California (Mus. No. 123578), April 11, 1891, Dr. A. K. Fisher; also additional specimens in the same region (Mus. No. 123579), April 18, 1891, Dr. Fisher and E. W. Nelson.

The foregoing species was described by me in the Proc. U. S. National Museum, Vol. XIII, pp. 207–208, from a few examples collected at or near the town of Magdalena, State of Sonora, Mexico, November 6, 1889, by Mr. Vernon Bailey. He detected it on a hill or mountain at an elevation of about 1,000 feet above the town. The latitude of Magdalena is about 31° N. The investigations of the Death Valley Expedition have carried it far to the north of the above, to the Panamint region of California, where both Dr. Fisher and Mr. Nelson obtained numerous living individuals. This discovery extends the area of the distribution of *H. magdalenensis* northerly between six and seven degrees of latitude. The place where these specimens were found in Johnson Cañon has an elevation of about 6,000 feet above the sea; the first lot (No. 123578) were mostly bleached shells. The Fisher-Nelson series (No. 123579) subsequently collected, is from a still higher elevation, viz. 8,000 feet; here twenty-five living examples were obtained, most of them mature. The Mexican locality may ultimately prove to be about the southerly limit of its distribution.

Helix (Arionta) coloradoensis Stearns.

Resting Springs, California (Mus. No. 123907), Vernon Bailey, February 12, 1891.

A single example, either alive when collected or quite fresh, was detected by Mr. Bailey, who found it among rocks on a dry hill 900 feet above the springs. It is nearly white, with the single band quite pale. This gives another locality to the above species, first found in the Grand Cañon of the Colorado, opposite the Kaibab plateau at an elevation of 3,500 feet, by Dr. C. Hart Merriam in 1890. The Resting Springs locality is in the southeastern part of Inyo County.

Helix (Arionta) mormonum Pfr.

Mineral King, Tulare County, Calif. (Mus. No. 123580), September 10, 1891, Vernon Bailey.

The single fresh specimen, hardly mature, was found among rocks about 1,000 feet below the timber line, above the Empire mine.

Helix (Arionta) tudiculata W. G. B.

Three Rivers, Tulare County, Calif. (Mus. No. 123581), T. S. Palmer, July 27, 1891.

Three specimens, one a fine living example, found at a point 850 feet above the sea. These illustrate the trifling value that should be given to the umbilical character in many of the land shells. The specimens from which the author wrote his description were *imperforate*, while the best example of Palmer's has an entirely open umbilicus, the same as many other individuals that I have observed before. A large series will be seen to run from one extreme to the other, the variability of this feature being the constant factor, paradoxical as it may appear.

Helix (Arionta) cypreophila Newc.

?=*H. tudiculata* W. G. B., variety.

Three Rivers, Tulare County, Calif. (Mus. No. 123582), July 27, 1891. T. S. Palmer.

Two examples, probably whole and fresh if not living at the time they were collected, were detected by Mr. Palmer in the above region, at an elevation of 850 feet. Dr. Newcomb's specimens were found at or near Copperopolis, in Calaveras County, Calif. Binney regards it as a variety of *tudiculata;* it may be so. It is, however, so rare that I have never seen specimens enough to enable me to come to a conclusion. Mr. Palmer's examples, though imperfect, conspicuously exhibit the characters that separate it from *tudiculata*. Perhaps a large series of specimens might satisfactorily connect the two. The dentition and genitalia have been investigated and were found by Mr. Binney to be the same as in *tudiculata*. Judging by the Palmer shell it is, to say the least, a decidedly well-marked variety.

Helix (Arionta) arrosa Gould.

Boulder Creek, Santa Cruz County, Calif. (Mus. No. 123583), Vernon Bailey, October, 1891.

A single example, which may be regarded either as a dwarfed *arrosa* or an elevated form of *exarata;* the latter is probably a geographical aspect of *arrosa;* Hemphill catalogues *exarata* as a variety of *arrosa*.

Helix (Praticola) griseola Pfr.

Hidalgo, Tamaulipas (Mus. No. 123584), and Monterey, Mexico (Mus. No. 123908), February, 1891; also Brownsville, Tex. (Mus. No. 123585), William Lloyd, July, 1891.

The three Texas shells are fine, broadly banded examples and dark colored; the others of the general or usual aspect.

Helix (Praticola) berlandieriana Mor.

Nueces Bay, San Patricio County (Mus. No. 123586), December, 1891, and Matagorda Peninsula, Texas (Mus. No. 123587), January 30, 1892, William Lloyd.

Numerous examples from the former and two from the latter locality.

Helix (Mesodon) thyroides Say.

Natividad River, Texas (Mus. No. 123588), William Lloyd, January 4, 1892.

Four fine specimens, one immature; two with a small parietal tooth, all of a dark amber horn color, and lustrous glazing. These beautiful examples, while fully as elevated as the larger of the three figures (337) in Binney's Manual of American Land Shells, Bull. U. S. National Museum, No. 28, p. 315 (*M. bucculentus*), are somewhat larger and slightly angulated at the periphery. The umbilicus is covered, peristome moderately thick, size of shell considered. These are links in the chain of connection of the typical *thyroides* with the *bucculentus* aspect.

Helix (Polygyra) texasiana Mor.

Natividad River, Texas (Mus. No. 123589), William Lloyd, January 4, 1892.

Two examples of this somewhat puzzling group. A comparison of Bland's *triodontoides* and Pfeiffer's *bicruris* creates the suspicion that a large geographical series might result in placing two of the three species in the waste basket of synonymy.

Helix (Polygyra) bicruris Pfr.

Brownsville, Tex. (Mus. No. 123594); Mouth of Rio Grande, Texas. (Mus. No. 123168). William Lloyd.

Two examples, mature and perfect, from the first and one from the last named locality. Heretofore credited to Mexico.

Pupa (Vertigo) pentodon Say.

Vegas Valley, Lincoln County, Nev. (Mus. No. 123590), Vernon Bailey, March 7, 1891.

The dozen or more examples of this tiny shell were detected by Mr. Bailey at Cottonwood Springs at the east base of the Charleston Mountains, otherwise known as the Spring Mountain range, of which the principal elevation is called Charleston Peak. The region is in the most southern part of Nevada. This species has not before been detected so far to the west or anywhere within the vast area of the Great Basin or the Pacific States.

Bulimulus dealbatus Say.

Monterey, Mexico (Mus. No. 123909), William Lloyd, February, 1891.

Four characteristic examples, mature and immature; dead shells.

Bulimulus alternatus Say.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123592); Brownsville (Mus. No. 123691); and Nueces Bay, San Patricio County, Tex. (Mus. No. 123593), William Lloyd, December, 1891.

The four Mexican specimens are very fine examples of this species and well illustrate the propriety of Say's specific name. The alternation of the irregular, somewhat diaphanous, longitudinal bands with others of a more opaque aspect is quite striking. The examples from the Texan localities are of the ordinary aspect.

Bulimulus serperastrus Say.
Hidalgo, Tamaulipas, Mexico (Mus. No. 123595), William Lloyd.

Three good examples of this pretty species, the largest 25^{mm} long. Like other species of the group, it varies considerably. Some individuals are much slenderer than others; hence, quite likely, the following synonyms from Binney's Land and Fresh Water Shells of North America (Part I, fig. 335, p. 192):

Bulimus liebmanni Pfr.
Bulimus ziebmanni Rve
Bulimus nitelinus Rve.

I agree with Binney; he is no doubt correct in the above inclusion. Perhaps the *californicus* of Reeve, Conch. Icon., 378, is a geographical aspect of *serperastrus*.

Succinea luteola Gould.
Hidalgo, Mexico (Mus. No. 123596), William Lloyd.

Three examples of fresh specimens.

Succinea oregonensis Lea.
Kern River, California (Mus. No. 123597), Vernon Bailey.

The four living examples were detected by Mr. Bailey at an elevation of 2,700 feet.

Suborder *HYGROPHILA*.

Limnæa caperata Say.
Ash Meadows, Nevada (Mus. No. 123598), Dr. A. K. Fisher.

Numerous specimens, all dead and bleached. Some of these are moderately angulated on the upper part of the basal whorl following the suture; others strongly malleated; all of them are rather solid, and the surface in many instances nearly smooth; in some examples the incremental lines are sharply defined; in one the basal whorl is quite shouldered above and malleated below, with hints of interrupted threadlike keels (liræ), on the same whorl near the columella. Cooper (Geog. Cat. No. 348) credits this species to 'S. F. to Oregon,' 'Eastern States.' Hemphill includes it (No. 91) in his little catalogue of the land and fresh water shells of Utah. Call credits it living to 'Warm Springs Lake' in the Bonneville Basin, Bull. U. S. Geol. Survey, No. 11, 1884. My remarks relating to *Limnæa palustris* in Proc. U. S. National Museum, Vol. XIV, 1891, are also applicable to the foregoing species.

Limnæa nuttalliana Lea.
=*L. palustris* Mull., var.
Panamint Valley, California (Mus. No. 123599), Dr. C. Hart Merriam.

Several examples with an unusually acute drawn-out spire; the largest a nearly typical *nuttalliana*; nevertheless, this, like many other so-called species of *Limnæa*, is but a local expression or variety of the world-wide *palustris*.

Attention is called to my remarks under *Limnæa lepida* of the previous year's collection (1890), in Proc. U. S. National Museum, Vol. XIV, 1891.

Limnæa humilis Say.

Kelton, Utah Territory (Mus. No. 123600), Vernon Bailey, November 7, 1891.

One specimen in the "dry clay wash, about 100 feet above the level of the lake."

Limnæa bulimoides Lea.

Mohave River, near Daggett, Mohave Desert, San Bernardino County, Calif. (Mus. No. 123910), Dr. C. Hart Merriam, March 31, 1891.

Six examples of this rather rare form, all dead and bleached. Described by the late Dr. Lea, in 1841, from examples collected by Nuttall in Oregon. Since found at many places in the Pacific States and in the Yellowstone region by Hayden's Survey.

Planorbis lentus Say.

Ash Meadows, Nevada (Mus. No. 123601), F. Stephens, March 2, 1891. Same region (Mus. No. 123602), Dr. A. K. Fisher, March 15, 1891. Panamint Valley, California (Mus. No. 123603), Dr. C. Hart Merriam. Brownsville, Tex. (Mus. No. 123604), William Lloyd.

Only a few examples of the above are mature or full grown; these, though of rather rude growth compared with specimens from more southerly and less arid regions, are much closer to what Say describes as *lentus* than to his *trivolvis*.

Planorbis liebmanni Dkr.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123606), William Lloyd, March, 1891.

Numerous examples of this easily recognizable species.

Planorbis parvus Say.

Mohave River near Daggett, Mohave Desert, San Bernardino County, Calif. (Mus. No. 123911), Dr. C. Hart Merriam, March 31, 1891.

Three examples, bleached.

Planorbis trivolvis Say.

Fresno, Calif. (Mus. No. 123605), Vernon Bailey, September 22, 1891. Keeler, Calif. (Mus. No. 123615), T. S. Palmer, June 1, 1891. Daggett, Calif. (Mus. No. 123912), Dr. C. Hart Merriam, March 31, 1891.

Mr. Bailey's Fresno shells were collected by him in an irrigation ditch. The specimens, of which there are several, were found living. None of them are adult, being most of them but half grown; at this stage they might be labeled *P. tumens* Cpr. Palmer's Inyo County examples are dead shells, none adult, being about the same age as Bailey's. All of the above are simply young *trivolvis*. Dr. Merriam's locality is in the Mohave Desert, near the river of the same name, in San Bernardino County. Some of the examples are nearly typical *trivolvis*, others exhibit the *corpulentus* aspect. In both the growth lines are quite conspicuous. The latter are listed herein as *P. trivolvis* var. (Mus. No. 123913.)

Physa gyrina Say.

Hot Springs, Panamint Valley, California (Mus. No. 123607), April 22, 1891; also Pahranagat Valley, Nevada (Mus. No. 123608), May 25, 1891; Daggett, Mohave Desert, California, March 31, 1891 (Mus. No. 123914), Dr. C. Hart Merriam. Garlick Springs, San Bernardino County, Cal. (Mus. No. 123609), March 14, 1891; Resting Springs, Inyo County, February 9, 1891 (Mus. No. 123916); Keeler, Inyo County, Calif. (Mus. No. 123610), June 1, 1891; Gorman Station, 8 miles south of Fort Tejon, Cal., July 2, 1891 (Mus. No. 123611), T. S. Palmer. Kern River, California (Mus. No. 123612), and Fairfield, Utah (Mus. No. 123613), June 25, 1890, Vernon Bailey. Hidalgo, Tamaulipas, Mexico (Mus. No. 123614); Monterey, Mexico (Mus. No. 123915), William Lloyd.

Dr. Merriam's Hot Springs examples of the above are fine large dark-colored shells; they vary considerably in elevation of spire. In the shorter spired individuals there is a tendency to tabulation or flattening of the upper part of the body whorl, following the suture, suggesting the shouldered aspect of *Physa humerosa*, a common form on the surface of the Colorado Desert. His Pahranagat Valley lot are paler and more elongated, with a higher and more acute spire, suggestive of *P. hypnorum*.

Palmer's Garlick Springs shells are nearer the typical form; taken as a whole, in size, color, and general facies; some of them hint of Tryon's species *diaphana*, a local varietal aspect of *gyrina*, found in the neighborhood of San Francisco Bay. His Keeler examples, from the shores of Owens Lake, are few in number; two of these are over rather than of the usual size, and two are hardly adult; all are characteristic, form considered. The Gorman Station lot, of which there is a large number, also collected by Palmer, at a point 8 miles south of Fort Tejon, are exceedingly uniform in size, color, and proportions; they are all adults, of medium size, rather slenderer on the whole than the typical form, but not as slender as Merriam's Pahranagat examples. Bailey's five specimens from the South Fork of Kern River, at an elevation of 2,700 feet, are apparently adults of a dwarfed form, less than half the size of average typical adults; his Fairfield specimens were found in a spring. At the first Mexican locality Mr. Lloyd found a single individual; at Monterey, seven specimens; these latter exhibit the modifications in texture, solidity, etc., which so frequently characterize northerly forms of this and allied groups, where the distribution extends into southerly or warmer regions.

Physa heterostropha Say.

Bennett Spring, Meadow Valley, Nevada (Mus. No. 123616), Dr. C. Hart Merriam, May 20, 1891. Owens Valley, Inyo County, Calif. (Mus. No. 123617), F. Stephens, July 7, 1891. Hot Springs, Panamint Valley, California (Mus. No. 123618), Vernon Bailey, January 9, 1891. Brownsville, Tex. (Mus. No. 123619), William Lloyd.

Dr. Merriam's Bennett Spring shells were found by him at a point 7 miles west of Meadow Creek, at an elevation of 6,000 feet; they range from adolescent to mature, the largest being rather under than up to the usual adult mean. Stephens' specimens are all of one size, under rather than up to the average mean of adults, and of that perplexing aspect so frequently exhibited in the fresh-water snails, that make the use of one specific name instead of another simply an arbitrary matter. They would pass as subspecies of the above, or *gyrina*. The numerous examples were detected at Moran's, near Benton, Calif., at an altitude of 5,000 feet. Bailey's Panamint Hot Springs specimens are hardly more characteristic; they point suggestively to the *humerosa* form, of the Colorado desert. Lloyd's two Texas examples are dark amber colored and rather solid shells.

Carinifex newberryi Lea.

Keeler, Inyo County, Calif. (Mus. No. 123620), T. S. Palmer.

Numerous examples, in a bleached and semi-fossilized condition. These exhibit, as is not unusual with this form, considerable variation. As additional information comes to us from time to time, the great range of this species, first detected by Dr. J. S. Newberry, in the Klamath Lake region of northern California, near the Oregon line, and described by Dr. Lea in 1858, becomes exceedingly instructive and interesting. Hemphill collected it living in the neighborhood of Keeler, which is near the margin of Owens Lake, several years ago. Dr. Edward Palmer obtained it in Utah Territory, near Utah Lake, in the Wahsatch Mountains, and it has been found in the Tertiaries of Nevada (King's Survey). "In the Lahontan Basin it ranges from the shores of Walker's Lake, north to Button's Ranch, Christmas Lakes, Oregon, where it is found semi-fossil" [Call]. Utah Lake is the easternmost locality as yet known.

Order PROSOBRANCHIATA.

Suborder *PECTINIBRANCHIATA.*

Section TAENIOGLOSSA.

Amnicola micrococcus Pilsbry, sp. nov.

Shell minute, globose, with short conic spine and narrow umbilicus. Whorls $3\frac{3}{4}$, convex, especially below the sutures, the apex very obtuse. Surface smooth, light olive colored. Aperture ovate, about half the length of the entire shell, bluntly angled above; the inner lip is either free from the preceding whorl, or in contact only at the upper part. Alt. 1.5, diam. 1.3^{mm}.

Fig. 1. Amnicola micrococcus.

A smaller species than *A. granum* Say, with oval instead of round aperture and shorter spire.

Type from small spring in Oasis Valley, Nevada (Mus. No. 123622), Dr. C. Hart Merriam, June, 1891. Collected also in Death Valley by Nelson and Bailey, February 4, 1891 (Mus. No. 123904).

Several examples of this quite minute shell were detected in a small spring. This is a form not heretofore observed and an exceedingly interesting little species. It was referred to Mr. Pilsbry for determination and description.

Amnicola porata Say.

Kelton, Utah (Mus. No. 123625), Vernon Bailey, November 7, 1891.

Two examples in the dry clay wash about 100 feet above the lake.

Bythinella protea Gould (Stearns).

=*Amnicola protea* Gould, 1855.*

=*Melania exigua* Conrad, 1855.

=*Tryonia protea* Binney et auct.

+*Bythinella seemani* Frau. (Pilsbry).

=*Hydrobia seemani* Frau. 1863.†

Saratoga Springs, Death Valley (Mus. No. 123905); January 30, 1891, E. W. Nelson; February 4, 1891, Vernon Bailey.

Several hundred living specimens were obtained at the springs by Mr. Nelson and a large number in a marsh near the springs by Mr. Bailey. Associated with them were a few examples of *Amnicola micrococcus* Pilsbry before mentioned.

In explanation of the foregoing synonymy it should be stated that *Bythinella protea* is an exceedingly variable form, including examples that have a perfectly smooth surface, and others that are variously sculptured. In all, whether sculptured or otherwise, *the apex whorls are smooth.* The smooth form, like those referred to below, has the appearance in every respect of an attenuated, slender drawn out *Bythinella*, like *nickliniana*, described by the late Dr. Lea in 1839, and it, *protea*, may ultimately be regarded as belonging to Lea's species.

B. seemani as identified by Mr. Pilsbry appears to be the smooth variety or aspect of Gould's *Tryonia protea* (=*Melania exigua* Conrad).

Frauenfeld's description is based upon examples from Durango, Mexico. The National Museum contains a number of specimens from Andocutira in the State of Michoacan, Mexico, from the bed of an ancient lake. These latter are no doubt the same as the Durango shells; they are perfectly smooth, of a porcellaneous whiteness and texture, and in no way different from the smooth form of *B. protea*, with which they have been repeatedly and carefully compared. The Michoacan region is nearly 1,800 miles south of the Colorado desert.

The granulose form or variety agreeing with figs. 141 and 142 of Binney,‡ was detected near the line of the Southern Pacific Railroad in June, 1888, by Mr. C. R. Orcutt, of San Diego. He found them living in pools at Indian or Fish Springs, some 15 miles northwest of the station on said road, known as Salton. The pools, of which there are several, varying from 10 to 20 feet across, are situated at the base of the San Jacinto range of mountains. They are only a few feet deep and are

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* Pacific Railroad Reports, v, 1855, p. 332.

† Verhandlungen der k. k. zoologisch-botanischen Gesellschaft in Wien, Jahrgang 1863, p. 1025.

‡ See Land and Fresh Water Shells of North America, Smithsonian Misc. Collections 144, Sept. 1865, p. 72.

surrounded and shaded by tules. The water is warm; in Mr. Orcutt's judgment not under 100° F., and tastes like the water of the Dos Palmas Spring, 6 miles north of Salton on the opposite side of the desert, at the base of the Chuckawalla or Lizard Mountains. "An analysis of the Dos Palmas Spring water gives slight traces of alum, soda and sulphur and shows that considerable salt is held in solution, but it is not too salt for use. These springs are all below the present sea level about 100 feet, judging from the fact that Salton lying in the depression between Dos Palmas and Indian Springs, is reported to be 250 feet below sea level from actual measurements." Specimens from this place kindly presented by Mr. Orcutt* are contained in the National Museum (No. 104886).

Mr. Pilsbry remarks as to *B. seemani*, "it is indeed much like a smooth *Tryonia*. I wonder whether the *Tryonias* are not simply examples of this, isolated in a gradually evaporating basin, becoming more and more saline! However this may be, the shells you submitted to me for my determination are the real *seemani*."

Gould's name *protea* is eminently appropriate; besides the smooth form herein discussed and inclusively regarded as the same as Frauenfeld's, and Orcutt's Indian Springs granulose examples, we find other varietal aspects and the sculpture varying between faint or barely discernible, to moderately defined or conspicuous. Sometimes the shells are shouldered or angulated on the upper side of the whorls, often traversed spirally by slender liræ or threads, and these again modified by longitudinal ribs or costæ. And the proportions of the shells in shape also vary exceedingly; sometimes drawn out, elongated, attenuated, and slender, again short and robust. The mouth smaller or larger; the whorls varying in convexity and all of these aspects of sculpture and form, are seen, when hundreds of specimens are examined, to intergrade or blend together in a greater or less degree. Occasionally there is an example that hints of Stimpson's *clathrata*, but I have not thus far been able to connect the two forms. Again referring to Mr. Pilsbry's note, writing of *seemani* he says "it is no doubt a *Bythinella*† related quite closely to our *nickliniana*."

Without here considering the niceties of generic distinction between *Hydrobia*‡ (in which Frauenfeld placed his species *seemani*), and *Bythinella*, it will readily occur to the reader, that a form so variable, would be likely in some phase of its variation to closely approach if not absolutely and inseparably resemble individuals of other species belonging to more or less intimately related, though geographically widely separated groups.

*See Orcutt's notes in West American Scientist, September, 1888, and May, 1889.

† Agreeing with Mr. Pilsbry on this point, it will be seen that I have adopted the generic name, *Bythinella*, for Dr. Gould's species.

‡ *Vide* Stimpson's Researches upon the Hydrobiinæ, etc., Smithsonian Misc. Coll., 201, August, 1865.

The suggestion that arises from the study of the forms above reviewed, and the regions and conditions to which they are related, point to the causes that induce variation, and to the permanency of species and genera, or to the mutability of the same, as dependent on environmental factors, forces, or conditions. If we are warranted in assuming or to indulge in the speculation, that with volume of water ample or *maximum* and *chemical proportions as related to volume minimum* our *Tryonias* would be smooth; and that the smooth form that so largely prevails or dominates in the various species of the *Bythinellas* and related groups is in a conventional sense of the word, normal, then we may reasonably assume that upon the reversal of these conditions which are environmental and apparently fundamental, with volume of *water mimimum* and with *chemical proportions as related to volume of water maximum*, these phenomena of variation may be attributed, because they are so generally coincident with the latter or alternative character of the environment, though temperature conditions probably have more or less influence.*

At times, no doubt, the flow of water from the springs where these forms occur is comparatively excessive, and there follows a limited local extension of distribution or occupancy in the immediate region, equal to the area covered by the overflow. With the decline of the waters and the evaporation or drying up that follows, the larger areas are inhabitable for awhile, as the mollusks of this general group possess remarkable vitality, and can live for a long time away from, or without water, in damp mud, by burying themselves below the surface.

The soil or mud in the immediate region of alkaline or saline springs, through repeated overflow and evaporation, becomes supersaturated with the bitter chemicals, and it would seem that in course of time these conditions might play some part in inducing variation in the progeny of those individuals that possessed sufficient vitality to survive or to adapt themselves to these conditions. In many places, it is not unreasonable to suppose that such or similar conditions are an ever-present and operative influence within the environment.

I have heretofore† called attention to the remarkable variation exhibited by the pond snails, *Physa*, of the Colorado Desert, so abundant in and around Indio. In these the sculptural feature has no part, but the forms present not only the normal aspect of several well-known species, but the varietal phases, furnish connecting links between them, as well as extraordinary extremes to the extent of distortion.

Now these alternations of conditions are exactly what have occurred within the vast area, in various places of which, these forms occur.

No doubt there are many other springs still living (flowing) within the general region that await examination. The territory inhabited by Gould's species includes not only the localities from whence Merriam,

*In this connection see Call's interesting and able paper "On the Quaternary and Recent Mollusca of the Great Basin," etc., Bull. 11, U. S. Geol. Survey, 1884.

†Am. Naturalist, October, 1883, pp. 1014–1020.

Nelson, Bailey, and Orcutt collected living examples, but places still farther north, in the Great Basin so-called; for certain forms collected by Dr. Yarrow* in 1872 on the shores of Sevier Lake, middle Utah, though unfortunately few in number and somewhat weathered, were regarded by the late Mr. Tryon, to whom the specimens were submitted, as "a representative of the genus *Tryonia*," and are referable to no other form. (Mus. No. 73960.)

In course of time living specimens from new localities may come to our knowledge, as they have within the past five years, since Orcutt led the way with his Indian Springs collection, and it may be found, that in springs where the water is comparatively permanent in volume and sweet, the smooth form prevails, and *vice versa*, so far as quantity and quality of water and the matter of shell characters. Information on these points is now what is wanted.

Tryonia clathrata Stimpson.

Pahranagat Valley, Nevada (Mus. No. 123,621), Dr. C. Hart Merriam, May 25, 1891.

This is the veritable form described by the late Dr. William Stimpson in February, 1865, from the dead bleached specimens collected by Prof. William P. Blake on the surface of the Colorado Desert, while connected with one of the Pacific Railroad surveys, nearly forty years ago. Prof. Blake found it together with other small fresh-water gastropod shells, including Gould's *Amnicola protea.* Subsequently Gen. Carlton collected several examples of *T. clathrata* while on his way east with his command in 1861–'62, but in neither case is the exact locality of Blake's or Carlton's specimens stated. In neither of the lots collected by them were there any living examples; all were of a porcelaneous whiteness, the same as the innumerable bleached specimens of the more common *protea-exigua* form, that are spread over the surface of the desert. Of the thousands of these latter that I have received and collected along the line of the Southern Pacific Railroad, not a single example of *clathrata* has rewarded me for the time expended in the effort to find a specimen by the subsequent examination of the material from this part of the desert. Dr. Merriam's find indicates a more easterly and less southerly distribution for *clathrata*, and quite likely it may prove to be less abundant than its ally. Dr. Merriam's examples were found in a hot spring; the temperature of the water as noted being 97° F.

Fluminicola fusca Hald.

Kelton, Utah Territory (Mus. No. 123623), Vernon Bailey, November 7, 1891.

Five semifossilized examples were detected in the dry wash of a clay bank at an elevation of about 100 feet above the lake.

Fluminicola merriami Pilsbry and Beecher.†

"Shell small, globose-turbinate, narrowly but distinctly and deeply umbilicated. Spire low-conic, acute; whorls four, slightly shouldered

*U. S. Geol. Survey, W. of the 100th Meridian, vol. v, p. 948.

†The Nautilus, vol. v, April 1892, p. 143.

below the sutures, the upper-lateral portion rather flattened, periphery and base convex. Surface smooth, horn-colored. Aperture oblique, ovate, angled above, broadly rounded below; upper portion of the inner lip adherent to the body-whorl, lower portion arcuate, without a callous thickening.

"Alt. 3, diam. $2\frac{1}{2}^{mm}$.

"Collected from a warm spring (temperature 97° F.) in Pahranagat Valley, Nevada, by Dr. C. Hart Merriam, and submitted to the writer by Dr. R. E. C. Stearns.

"This species differs from *F. fusca* Hald., in the much more distinct umbilicus, thin texture, and the *non-thickened* inner lip.

Fig. 2. Fluminicola merriami.

"Specimens may be seen in the National Museum (No. 123626) collected at Warm Springs, Pahranagat Valley, Nevada, by Dr. C. Hart Merriam, May 25, 1891."

This form, not previously described, is regarded by Mr. Pilsbry, who is an authority on the shells of this and allied groups, as a new species. It was found associated with *Tryonia clathrata*, elsewhere noted, the temperature of the water being 97° F.

Fluminicola fusca Hald. var. **minor**.

Ash Meadows, Nye County, Nevada (Mus. No. 123624), F. Stephens, March 4, 1891.

Numerous (200) living specimens of nearly uniform size in spring.

Fluminicola nuttalliana[*] Lea.

Shoshone Falls, Idaho (Mus. No. 58596).

A large number of specimens, probably as many as two hundred and fifty, were collected at this locality by Dr. Merriam (October 10, 1890), who found them clinging to the rocks in the stream. They vary considerably in elevation of the spire, etc., but the form of the mouth is quite persistent.

A dwarfed but characteristic aspect of this species occurs among the surface shells in the Colorado Desert.

Suborder *SCUTIBRANCHIATA*.

Section Rhipidoglossa.

Helicina chrysocheila Binney.

Hidalgo, Tamaulipas, Mexico (Mus. No. 123627); also Texas near the mouth of the Rio Grande (Mus. No. 123167), William Lloyd.

Four characteristic illustrations of this well marked and handsome species described in Binney's Terr. Air-breathing Moll., U. S., Vol. II, p. 354, 1851. In addition to the above number, two were obtained at the Texan locality.

[*] Inadvertently omitted in my previous list, but included in list published in N. Am. Fauna, No. 5, 1891, p. 27.

Helicina tropica Jan.

Brownsville, Tex. (Mus. No. 123628), William Lloyd.

A single example.

Class PELECYPODA.

Order TETRABRANCHIATA.

Suborder *SUBMYTILACEA.*

Anodonta nuttalliana Lea.

Keeler, Calif. (Mus. No. 123629), T. S. Palmer.

One semifossil example.

Unio anodontoides Lea.

Brownsville, Tex. (Mus. No. 123630); Mier, Tamaulipas, Mexico, May 4, 1891 (Mus. No. 123632), William Lloyd.

The Brownsville examples are less elongated than usual in this species. The Mexican specimens are full grown and of the usual proportions.

These localities are believed to be much farther south than heretofore reported.

Unio berlandieri Lea.

Mier, Tamaulipas, Mexico (Mus. No. 123631), William Lloyd, May 4, 1891.

The examples of this species are nearly full grown adults and of the characteristic aspect.

Suborder *CONCHACEA.*

Pisidium occidentale Newc.

Oasis Valley, Nevada (Mus. No. 123633), Dr. C. Hart Merriam, June 2, 1891.

Several examples. The above place is on the western edge of the Ralston Desert, in Nye County, Nevada.

NOTES ON THE DISTRIBUTION OF TREES AND SHRUBS IN THE DESERTS AND DESERT RANGES OF SOUTHERN CALIFORNIA, SOUTHERN NEVADA, NORTHWESTERN ARIZONA, AND SOUTHWESTERN UTAH.

By C. HART MERRIAM, M. D.

The present chapter is made up of a multitude of disconnected notes, jotted down on horseback while traversing the deserts and desert ranges of the southern part of the Great Basin. These notes relate to the vertical and geographical distribution of the trees and shrubs observed by me in April, May, and June, 1891, along the route traveled from the north end of Cajon Pass, in the San Bernardino Mountains, California, to the St. George Valley, at the foot of the Hurricane Cliffs, in southwestern Utah, and thence westerly across Nevada to Owens Valley, California, and southward and southwestward to the extreme end of the western tongue of the Mohave Desert (Antelope Valley), including the several passes (Walker, Tehachapi, and the Cañada de las Uvas) by means of which communication is established between the Mohave Desert on the southeast, and the Bakersfield Plain, or upper San Joaquin Valley, on the northwest. A detailed itinerary of this trip may be found in Part I of the report. In a few instances, notes made by other members of the expedition are added and duly accredited; a small number of non-woody plants are admitted to render the list more useful, and in addition to the desert species a few from the Sierra Nevada, mainly conifers, are included.

Most of the desert shrubs are social plants and are distributed in well marked belts or zones, the vertical limits of which are fixed by the temperature during the period of growth and reproduction. Since the temperature at this season in places of the same latitude depends mainly on altitude, base level, and slope exposure, it follows that the boundaries of the several belts conform largely to the contours of altitude, with such flexures as variations in base level and slope exposure impose.

The principal plant zones conform also to the animal zones, as defined by the limits of distribution of terrestrial mammals, birds, and reptiles. But since these *Life Zones* are discussed in the first part of the report they will not be considered here. It should be mentioned, however, that each of the life zones is subdivisible both latitudinally and longitudinally, and that while the former divisions are clearly dependent on temperature, the causes controlling the latter are not always well understood. Such local factors as soil and slope are not here referred to. The most marked longitudinal divisions, so far as the Great Basin is concerned, are those of the Lower Sonoran Zone, which may be designated the *Larrea* belt and the *Grayia* belt. The creosote bush (*Larrea tridentata*) is the most conspicuous, most widely distributed, and best-known bush of the torrid deserts of the southwest, where it covers the gravel soils up to a certain line, which probably marks the southern limit of killing frost. The *Larrea* belt is the most important of all from the horticultural standpoint, because it is suited to the requirements of the citrus fruits, the olive, almond, fig, and raisin grape. Associated with the *Larrea*, and coinciding with it in distribution, is the inconspicuous *Franseria dumosa*. Another species occupying the same gravel soils, but less generally distributed, is the beautiful and fragrant *Krameria parvifolia*. The alkali soils of the same belt are covered with greasewoods of the genus *Atriplex*, of which *A. polycarpa* is the most characteristic. The *Grayia* belt, named from its most distinctive and widespread bush (*Grayia spinosa*), occupies the strip between the upper limit of *Larrea* and the lower border of the true sage brush (*Artemisia tridentata*), which latter indicates the beginning of the Upper Sonoran Zone. Other shrubs of the *Grayia* belt are the dark *Coleogyne ramosissima*, which resembles *Krameria parvifolia* in general appearance, but belongs to a different order and has yellow flowers; the handsome *Tetradymia spinosa* and *T. glabrata*; the fetid *Thamnosma montana*; the stunted *Menodora spinosa*, whose conspicuous green berries always grow in pairs; and the singular *Salazaria mexicana*, whose inflated capsules are borne away by the wind and lodge in great numbers upon the spiny cactuses. Certain shrubs range over the whole breadth of the Lower Sonoran Zone, occurring alike in the *Larrea* and *Grayia* belts. The most noticeable members of this category are the olive-colored *Ephedra nevadensis*, which has no apparent foliage and is used as a medicine by the Indians and miners; the handsome *Daleas*, with their blue and purple flowers, and *Lycium andersoni*, which bears a small edible fruit.

The true sage brush (*Artemisia tridentata*) begins with a solid front along the southern border of the Upper Sonoran Zone and spreads northward over the Great Basin like a monstrous sheet, covering almost without a break hundreds of thousands of square miles. It is not only the most striking and widely diffused plant of the Upper Sonoran and Transition zones, but as a social plant has few equals, often occupying immense areas to the exclusion of all but the humblest and least conspicuous forms. Wherever one travels in this vast region, the aromatic odor of the sage brush is always present, and sometimes, particularly after rains, is so powerful as to cause pain in the nostrils.

In addition to the sage, many of the desert ranges support a growth of shrubs and small trees rarely if ever found on the intervening deserts and plains, whatever the altitude. This seems to be due in part to increased moisture and in part to the physical character of the slopes. The so-called cedar (*Juniperus californica utahensis*) and the piñon or nut pine (*Pinus monophylla*) clothe the summits and higher slopes of many of the ranges, forming stunted open forests of much beauty. Mixed with these are scattered clumps of bushes representing a number of genera, most of which bear green foliage and handsome flowers. Conspicuous among them are *Berberis fremonti*, *Ceanothus fremonti*, *Rhus trilobata*, *Robinia neomexicana*, *Cercis occidentalis*, *Prunus fasciculata*, *Kunzia tridentata* [until recently known as *Purshia*], *Cowania mexicana*, *Fallugia paradoxa*, *Amelanchier alnifolia*, *Peraphyllum ramosissimum*, *Garrya veatchii flavescens*, and *Symphoricarpos longiflorus*. Scrub oaks of two species (*Quercus gambelii* and *Q. undulata*) are common in places; the green *Ephedra viridis* is almost universally present, and the mescal (*Agave utahensis*) occurs on a few of the slopes.

Some of the desert ranges, as the Funeral Mountains, are too excessively hot and arid to support even these forms of vegetation; others, as the Charleston Mountains, push their lofty summits into so cold an atmosphere that they obtain a covering of the boreal pines and firs. These higher mountains, when rising from the Lower Sonoran deserts, present in succession all the extra tropical zones of North America, which, from their close juxtaposition, may be here studied to unusual advantage.

In ascending or descending such slopes the change from one zone to another is quickly recognized and the altitude of first appearance of the various new species encountered may be recorded with considerable confidence. Not so, however, with the species lost, for, except in the case of trees and such strikingly conspicuous forms as the yuccas, some of the cactuses, the creosote bush (*Larrea*), and a few others, it is exceedingly difficult to detect the disappearance of species when passing out of their ranges. A close parallel occurs in the study of bird migration. Every observer reports the first appearance of the newcomers in spring, while but few have any record of disappearance in autumn.

In order to make sure of the upper and lower limits of species on a mountain side the same line should be traversed both up and down the slope, which it was impossible to do in the limited time at our disposal. In cases where this is done the resulting altitudes relate to a particular slope only and too often to a cañon or wash on that slope, so that they can not always be accepted as fair averages for the base level and slope exposure to which they properly pertain.

Most of the altitudes were determined by aneroid barometer and are only approximate, because of the scarcity of base stations of known elevation. All altitudes are recorded in meters, and equivalents in English feet are given in parentheses. These equivalents are stated in round numbers to avoid the appearance of a degree of precision unwarranted by the altitudes themselves. While in some instances the absolute altitudes are doubtless considerably in error, their relative values are not impaired, for they still serve to show the vertical extent of the belts occupied by the various species and the elevation in respect to fixed points.

For aid in the determination of species I am indebted to my assistant, Mr. Vernon Bailey, who was with me in the field, and to Mr. F. V. Coville, botanist of the expedition, who unfortunately was with me only ten days at the end of the trip. Mr. Coville is responsible for the nomenclature and sequence of genera here adopted.

LIST OF TREES AND SHRUBS.

Berberis fremonti.
Arctomecon californicum.
merriami.
Stanleya pinnata.
Isomeris arborea.
arborea globosa.
Krameria parvifolia.
canescens.
Malvastrum rotundifolium.
Sphæralcea monroana.
Fremontodendron californicum.
Larrea tridentata.
Thamnosma montana.
Mortonia scabrella.
Glossapetalon nevadense.
spinescens.
Rhamnus crocea.
Ceanothus fendleri.
divaricatus.
cuneatus.
Æsculus californica.
Acer negundo.
Rhus trilobata.
diversiloba.
Dalea polyadenia.
fremonti.
johnsoni.
Robinia neomexicana.
Cassia armata.
Cercis occidentalis.
Prosopis juliflora.
pubescens.
Acacia greggii.
Prunus fasciculata.
virginiana (or *demissa*).
andersoni.
Basilima millefolium.
Holodiscus discolor.
Adenostoma fasciculatum.
Kunzia glandulosa.
tridentata.
Coleogyne ramosissima.
Cercocarpus ledifolius.
parvifolius.
Cowania mexicana.
Fallugia paradoxa.
Rosa sp. —?
Heteromeles arbutifolia.
Amelanchier alnifolia.
Peraphyllum ramosissimum.
Ribes leptanthum brachyanthum.
menziesii.
Petalonyx parryi.
Eucnide urens.
Garrya veatchii flavescens.
Symphoricarpos longiflorus.
Amphiachyris fremontii.
Acamptopappus sphærocephalus.
Aplopappus monactis.
Bigelovia douglassi.
graveolens.
teretifolia.
Baccharis glutinosa.
Pluchea sericea.
Hymenoclea salsola.
Franseria dumosa.
eriocentra.
Encelia frutescens.
Artemisia tridentata.
spinescens.
arbuscula.
filifolia.

LIST OF TREES AND SHRUBS—continued.

'eucephyllum schottii.
'etradymia canescens.
glabrata.
spinosa.
comosa (or *stenolepis*).
rctostaphylos glauca.
pungens.
Menodora spinescens.
Fraxinus coriacea.
anomala.
Eriodictyon tomentosum.
Lycium andersoni.
cooperi.
pallidum.
torreyi.
'hilopsis linearis.
'alria carnosa.
pilosa.
'alazaria mexicana.
triplex canescens.
confertifolia.
hymenelytra.
lentiformis.
parryi.
polycarpa.
torreyi.
'rayia spinosa.
'urotia lanata.
llenrolfea occidentalis.
'ada suffrutescens.
arcobatus baileyi.
vermiculatus.
'riogonum polifolium.
inflatum.
horizanthe rigida.
latanus occidentalis.
etula occidentalis.
Alnus rhombifolia.
Quercus undulata.
gambelii.
lobata.
douglasii.
wislizeni.
kelloggii.
dumosa.
Castanopsis chrysophylla.
Salix longifolia.
lævigata.
nigra.
Populus fremontii.
Ephedra nevadensis.
viridis.
Pinus monophylla.
ponderosa.
ponderosa scopulorum.
jeffreyi.
murrayana.
balfouriana.
aristata.
sabiniana.
monticola.
lambertiana.
flexilis.
Abies magnifica.
concolor.
Pseudotsuga macrocarpa.
Sequoia gigantea.
Libocedrus decurrens.
Juniperus californica.
californica utahensis.
occidentalis.
occidentalis monosperma.
Tumion californicum.

erberis fremonti.

This large shrub, bearing handsome yellow flowers, is common on he less arid of the desert ranges, where it was observed in the follow-ıg localities:

EVADA.

Charleston Mountains.—Found on west slope, near Mountain Spring, t an altitude of 1,680 to 1,770 meters (5,500–5,800 feet).

Pahranagat Mountains.—Common, and ranges down on the east slope o 1,580 meters (5,200 feet).

Hungry Hill Summit.—Common, beginning just north of the summit nd passing down the south side toward the North Arm of Indian pring Valley to 1,525 meters (5,000 feet).

UTAH.

Beaverdam Mountains.—Abundant, ranging down to 1,350 meters (4,400 feet) on the west slope, and to 1,100 meters (3,600 feet) on the east slope. In full bloom May 11; flowers deep rich yellow.

Upper Santa Clara Valley.—Begins about 13 kilometers (8 miles) northwest of St. George, at an altitude of about 1,280 meters (4,200 feet), and ranges thence northerly, scattering over the rocky hillsides.

Arctomecon californicum.

One of the most interesting incidents in the botanical line connected with the present expedition is the rediscovery of this elegant poppy, the type of which was collected by Fremont in Vegas Desert, southern Nevada, May 3, 1844.* On the very same spot, and within forty-eight hours of the same day of the month (May 1, 1891), Mr. Bailey and I found the species in full bloom, growing in large patches, and secured a fine series of specimens. With it was a second species equally large and handsome, but having white instead of yellow flowers, which proved to be undescribed, and which has been since named *A. merriami*. *A. californicum* was afterward found near Bitter Springs in the Muddy Mountains (May 5), and in the Amargosa Desert between Ash Meadows and Oasis Valley (May 31).

Arctomecon merriami.

As stated above, this new and handsome poppy, with white flowers measuring 50^{mm} (about 2 inches) in diameter, was discovered by Mr. Vernon Bailey and myself in Vegas Desert, southern Nevada, between Lower Cottonwood Springs and Vegas Spring, May 1, 1891. It was found in company with the yellow-flowered species (*A. californicum*), from which it differs in the leaves and fruit as well as in the flower. The botanist of the expedition, Mr. F. V. Coville, has paid me the compliment of attaching my name to the species and has figured it in his forthcoming report.†

Stanleya pinnata.

This miserable crucifer, which attains a height of 4 or 5 feet, has a woody base, while the top is herbaceous. It was not seen in Utah nor eastern Nevada, but was common in some of the deserts of western Nevada and eastern California. It or a closely allied species was noted at the following localities:

CALIFORNIA.

Owens Valley.—Common in places, and ranging up the west slope of the White Mountains to 1,970 meters (6,500 feet).

Deep Spring Valley.—Common in the higher parts of the valley.

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*Rept. of Exploring Expedition to Rocky Mountains in 1842 and to Oregon and North California in 1843-'44, by Capt. J. C. Fremont, Washington, 1845 (Senate Doc. 174, Twenty-eighth Congress, second session), p. 312, Botany, Pl. II.

†Proc. Biol. Soc., Washington, vol. VII, May 18, 1892, p. 66.

NEVADA.

Fish Lake Valley.—Not found in the bottom of the valley, but tolerably common on the southeast side up to an altitude of 1,950 meters (6,400 feet) in a wash leading up towards Pigeon Spring, on the northwest slope of Mount Magruder.

Grapevine Cañon.—Occurs in the upper part of the cañon.

Sarcobatus Flat.—Tolerably common in places in the northern part of the flat.

Oasis Valley.—Occurs sparingly.

Pahranagat Valley.—Common in places, ranging up to about 1,525 meters (5,000 feet) on the west side of the valley.

Isomeris arborea.

The hills at the head of Antelope Valley, at the extreme west end of the Mohave Desert (altitude 1,160 meters, or 3,800 feet) were dotted with clumps of *Isomeris*, bearing yellow flowers and large inflated pods, the last week in June. It was abundant in a wash leading south from this point toward Peru Creek, and was found also in the lower part of the open cañon leading from Mohave up to Tehachapi.

Isomeris arborea globosa.*

This new subspecies of *Isomeris* was described by Mr. Coville from specimens collected near Caliente, at the head of the San Joaquin Valley, California, where we found it common along Caliente Creek, a few miles east of the station, June 24, 1891.

Krameria parvifolia.

This small and scrubby bush is very characteristic of the lower Sonoran deserts, but is not so generally distributed as some other species—notably *Larrea* and *Franseria*. It flowers profusely throughout the month of May, when it is literally buried in a mass of fragrant violet-purple blossoms. During the latter part of the month its spiny berries begin to show before it is wholly out of flower. During the remainder of the year it is easily mistaken for *Coleogyne*, though growing at a lower altitude. The following notes on its distribution were recorded:

NEVADA.

Pahrump Valley.—Common on the east side of the valley, ranging up to 1,340 meters (4,400 feet) on the west slope of the Charleston Mountains.

Indian Spring Valley.—Common throughout the valley, reaching up in the North Arm among most of the *Larrea* areas. It was still in flower in Indian Spring Valley May 29, and in fruit the same date in the Amargosa country.

Pahranagat Valley.—Common on gravel soil, where it is mixed with *Grayia*, *Lycium*, *Larrea*, and *Dalea*. In a wash leading from Pahroc Plain to Pahranagat Valley it occurs as high as 1,310 meters (4,300 feet) in company with *Franseria dumosa* (still in bloom May 22–26).

* Proc. Biol. Soc. Wash., vol. VII, May 18, 1892, p. 73.

Valley of the Virgin and Lower Muddy.—Common in the dry parts of the valley.

UTAH.

Santa Clara Valley.—Abundant in the lower part of the valley, disappearing at an altitude of 1,220 to 1,275 meters (4,000–4,200 feet).

Beaverdam Mountains.—On the west slope of the Beaverdam Mountains *Krameria* ranges up from the Virgin Valley to 1,150 meters (3,800 feet).

Krameria canescens.

This species was common in dry parts of the valleys of the Muddy and Virgin, Nevada. It is larger than *Krameria parvifolia*, from which its flowers differ in color and fragrance.

Malvastrum rotundifolium.

This exquisite species, whose large cup-shaped orange-pink flowers seemed disproportionately heavy for its slender stems, is common in the hottest deserts of eastern California and southwestern Nevada. It was found in the Mohave Desert, and in Panamint and Death valleys and the Amargosa Desert, but not in the deserts of eastern Nevada. It was common on the west side of the cañon leading from the Amargosa to the west end of Indian Spring Valley, but was not observed in the latter valley. It blossoms early and was in fruit about the end of May.

Sphæralcea monroana.

This common and widely distributed species (if only one species is covered by the notes), grows in enormous patches in some of the deserts of the Great Basin, where it becomes a truly social plant, the individuals standing so near together that their large salmon-colored flowers give color to areas miles in extent. Among the many places where it was seen are the following:

CALIFORNIA.

Mohave Desert.—Common in places.

Leach Point Valley.—Common.

Owens Valley.—Common, ranging up to 1,980 meters (6,500 feet) on the west slope of the White Mountains opposite Big Pine.

NEVADA.

Fish Lake Valley.—Common, ranging up on the northwest slope of Mount Magruder to 1,980 or 2,040 meters (6,500 or 6,700 feet).

Grapevine Cañon.—Common.

Sarcobatus Flat.—Common in places.

Amargosa Desert.—Occurs.

North Arm of Indian Spring Valley.—Abundant everywhere.

Emigrant Valley.—Abundant, and reaches up on the Desert Range nearly to the divide near Summit or Mud Spring.

Timpahute Valley.—One of the principal plants.

Pahranagat Valley.—Common, ranging up to 1,580 meters (5,200 feet) the Pahranagat Mountains.

Pahrump Valley.—Common.

Vegas Valley.—Enormously abundant, giving color to more than half e area of the valley between Lower Cottonwood and Vegas springs.

emontodendron californicum.

This handsome small tree (6 to 7 meters or 20 to 25 feet in height), ich bears large and showy yellow flowers, grows in great abundance d perfection on the lower slopes of the Sierra Nevada, west of the vide, and on the Coast Ranges, but does not occur anywhere within e limits of the Great Basin.

LIFORNIA.

Walker Pass.—Reaches the summit of the pass from the west and is undant thence down into the valley of Kern River, and from Kernlle north to Havilah and Walker Basin (in full flower June 20–24).

Cañada de las Uvas.—Common, and still in flower on the higher untains, June 28.

rea tridentata.

The creosote bush (*Larrea tridentata*) is the most characteristic, conicuous, and widely distributed of the desert brush of the Lower noran Zone, covering the gravel soils, wherever of suitable altitude, erywhere from the east foot of the Sierra Nevada in California to the lley of the Lower Santa Clara in Utah. Its dark green leaves and ckish stems render it conspicuous among all the other species with ich it happens to be associated, so that it is easily distinguished at istance, and hence is the most important zone plant in tracing the undary between the upper and lower divisions of the Lower Sonoran ne. It is true that several other species—notably *Franseria dumosa*—ee with it essentially in distribution, but they are so inconspicuous t it would be difficult to trace the zones by their aid alone. The folving notes respecting the details of its distribution were recorded:

IFORNIA.

Mohave Desert.—Universally distributed over suitable soils, reaching far west as the extreme upper limit of the lower division of the Lower noran Zone in Antelope Valley, which is about 6½ kilometers (4 miles) t of the Liebre ranch along the middle and north part of the valley, not quite so far west on the south side. On the north side of the have Desert, opposite the town of Mohave, it finds its upper limit 940 meters (3,100 feet), just reaching the mouth of the open cañon ding to Tehachapi Valley. On the south side of the Mohave Desert r Cajon Pass it reaches its northern limit at 1,020 meters (3,350 t). It does not cover the desert ranges in the Mohave Desert, and s short of the divide at Pilot Knob or Granite Mountain (altitude 00 meters or 4,600 feet).

Walker Pass.—At the east end of Walker Pass it ascends to 1,05 meters (3,400 feet), and on the south slope of the hills on the north sid of the entrance to this pass reaches 60 meters (200 feet) higher, or t 1,100 meters (3,600 feet).

Salt Wells Valley.—This valley is a true *Larrea* plain, and the *Larre* is continuous with that of the Mohave Desert.

Panamint Valley.—Common on the gravel soils, reaching up on th west slope of the Panamint Mountains as high as 1,500 meters (5,00 feet), and on favorable slopes to a still greater altitude. In Emigran Cañon (which slopes to the northeast) it stops at about 1,200 meter (4,000 feet).

Death Valley.—Common throughout the gravel slopes on both side of the salt bottom, where it was just beginning to flower April 7. (I was seen in flower in southern Arizona two weeks earlier.) It reache north through the lower part of the Northwest Arm of Death Valle (Mesquite Valley) as far as Grapevine Cañon, keeping on the gravel slopes, but does not occur much further north, the altitude being too great.

Owens Valley.—In Owens Valley, *Larrea* is restricted to the extreme southern end of the valley, except along the east side where it ranges for some miles north of Owens Lake, along the warm west slope at the foot of the Inyo Mountains, this being the hottest slope exposure of the valley. South of Owens Lake it occurs in scattering patches for several miles, and completely covers the broad valley between Haway Meadows and Little Owens Lake, this valley being a true *Larrea* plain.

NEVADA.

Amargosa Desert.—At the point where the clay soil of Ash Meadows changes to the gravel of the Amargosa Desert proper, *Larrea* begins with a solid front and ranges northward without interruption over the whole of the north arm of the Amargosa Desert, forming one of the purest *Larrea* plains met with. Throughout the greater part of this desert the *Larrea* is hardly invaded by any other plant except the small and inconspicuous *Chorizanthe rigida*. The *Larrea* on this desert is stunted, hardly averaging more than ⅔ of a meter (about 2 feet) in height, and along the northern edge of the desert is mostly dead; perhaps winter killed. It was heavy with its woolly fruit May 30, though a few blossoms were seen here and there. At the same date it was still in flower in Indian Spring Valley.

Oasis Valley.—Most parts of Oasis Valley are a little too high for *Larrea*, which forms a belt on favorable slopes hardly more than three miles wide. On good south and southwest slopes a scattering growth reaches as high as 1,370 meters (4,500 feet). To the east of the north end of Oasis Valley is a small valley draining into the east fork o Amargosa Creek in which a little *Larrea* occurs. It does not grow eas of the main part of Bare Mountains, or anywhere to the east or north east, the whole country being too high and the Lower Sonoran zone here reaching its northern limit for this part of Nevada.

Grapevine Cañon.—*Larrea* comes up solid through Grapevine Cañon from Death Valley, almost, but not quite, reaching Sarcobatus Flat, where it does not grow. On a southwest slope on the south side of Gold Mountain it attains an altitude of 1,620 or 1,650 meters (5,300 to 5,400 feet).

Indian Spring Valley.—*Larrea* completely covers Indian Spring Valley, here reaching its northern limit at the base of the low range of mountains which forms the northern boundary of the valley. In the north arm of Indian Spring Valley it reaches northward a little beyond Quartz Spring to an altitude of 1,525 meters (5,000 feet), or even a little higher on favorable slopes. It was still in flower in Indian Spring Valley May 29, and in fruit in the Amargosa country at the same date. It does not occur in Timpahute Valley.

Pahranagat Valley.—Common on the gravel benches and slopes of the southern half of the valley, but not evenly distributed. It reaches Pahranagat Valley from the south, coming up from the Muddy Valley through the broad cañon south of Pahranagat Lake and passing over the low divide (1,160 meters or 3,800 feet), whence it spreads northward over the low gravel slopes, becoming less abundant and more scattering until at an altitude of 1,250 to 1,280 meters (4,100 to 4,200 feet) it is found on south slopes only. It occurs in isolated patches in the broad wash leading into the valley from Pahroc Plain, where it has a southwest slope exposure, as high as 1,340 meters (4,400 feet). On the west side of the valley (east slope of Pahranagat Mountains) it is common about as far north as the middle of the valley, stopping, except in straggling patches, about 16 kilometers (10 miles) south of the latitude of Eisemann's ranch. It was still in full flower May 22–26.

Pahrump Valley.—Scarce on the west side of the valley and absent from the extensive clay flat in the bottom, but abundant everywhere on the long gravel slope on the east side, ranging up the west slope of the Charleston Mountains to 1,340 meters (4,400 feet), where it overlaps the tree yuccas.

Vegas Valley.—Abundant, covering the gravel soil of the whole valley and ranging up on the west side to 1,130 meters (3,700 feet), at the east foot of the Charleston Mountains.

Bend of Colorado and Muddy Mountains.—Common on suitable soils throughout the region bordering the Great Bend of the Colorado, and passing abundantly over the low summits of the Muddy Mountains west of the Virgin Valley.

Valley of the Virgin and Lower Muddy.—Abundant on suitable soil throughout these valleys and over the high gravel mesa between them, where it is the dominant bush along the boundary between Nevada and Arizona.

It does not reach northward as far as Meadow Creek Valley.

ARIZONA.

Beaverdam Mountains.—*Larrea* is abundant in the Virgin Valley near the mouth of Beaverdam Creek in northwestern Arizona, and reaches up on the west slope of the Beaverdam Mountains to 1,160 meters (3,800 feet).

UTAH.

Santa Clara Valley.—*Larrea* finds the extreme northeastern limit of its range in the Lower Santa Clara or St. George Valley in southwestern Utah, where it forms a sparse growth on gravel soils and disappears on southerly exposures on the north side of the valley at an altitude of 1,200 to 1,280 meters (4,000 to 4,200 feet).

Thamnosma montana.

This stinking bush, of a yellowish-green color and generally sprinkled with berry-like fruit about the size of peas, was common in many of the southern deserts traversed. It was noted in the following localities:

CALIFORNIA.

Mohave Desert.—Common in places.

Leach Point Valley.—Found sparingly.

NEVADA.

Charleston Mountains.—Common on the Charleston Mountains, where it ranges on the west slope from about 1,340 to 1,825 meters (4,400 to 6,000 feet). On the east slope it descends to 1,219 meters (4,000 feet) with *Coleogyne.*

Indian Spring Valley.—A few plants seen.

Valley of the Virgin and Lower Muddy.—Occurs sparingly.

ARIZONA.

Virgin Valley.—Found on the east side of the Virgin Valley near the mouth of Beaverdam Creek, whence it ranges up to 1,340 meters (4,400 feet) on the west slope of the Beaverdam Mountains.

UTAH.

Santa Clara Valley.—Occurs along the foot of the Beaverdam Mountains, ranging from 1,090 to 2,130 meters (3,600 to 4,300 feet).

Mortonia scabrella.

This bush was found by Mr. Bailey and myself on a limestone knoll in the valley of the Muddy, near Overton, Nev., May 6. It is remarkable for the peculiarity of its leaves, which are oval, conspicuously granular, and have thick margins that at first sight seem to be everted.

Glossapetalon nevadense.

This small bush was collected on the Pahroc Mountains near Pahroc Spring, Nevada, and a species supposed to be the same was found on the Beaverdam Mountains in southwestern Utah.

Glossopetalon spinescens.

This species was found on the Charleston Mountains, Nevada, near Mountain Spring.

Rhamnus crocea.

Common in California in the Cañada de las Uvas, and also on the Sierra Liebre; not recorded elsewhere.

Ceanothus fendleri.

Common on some of the desert ranges in the Great Basin, where it was observed in the following localities:

NEVADA.

Mount Magruder.—Common on the main peak with *Symphoricarpos.*

Charleston Mountains.—Common on the west slope, in the neighborhood of Mountain Spring, from 1,550 to 1,770 meters (5,100 to 5,800 feet), and perhaps higher.

Highland Range.—Found on the west slope.

UTAH.

Beaverdam Mountains.—Common on the east slope, at an altitude of 1,340 to 1,370 meters (4,400 to 4,500 feet).

Ceanothus divaricatus and **C. cuneatus.**

These species are common in the chaparral of the west slope of the Sierra and Coast Ranges in California. In Walker Pass they are common on the west slope from 1,430 meters (4,700 feet) downward, and range thence southerly along the west slope of the Sierra nearly to Caliente.

They are common also on the south slope of the Sierra Liebre.

Æsculus californica.

The handsome California buckeye, which grows to be a small tree, was in full bloom when we first saw it, the last week in June, on the west slope of the Sierra Nevada between Kernville and Walker Basin, and in the Cañada de las Uvas in the Tejon Mountains, a few days later. It usually grows on the sidehills, towering above the chaparral.

Acer negundo.

The box elder requires too much water to be common anywhere in the desert region proper. We found it along a running stream below Old Fort Tejon in the Cañada de las Uvas, in California, and along the Santa Clara River, in Utah, but not elsewhere.

Rhus trilobata.

In California this species was common on the west slope of the Sierra between Walker Basin and Caliente, and on the Sierra Liebre. In Nevada it was found in scattered clumps on the Charleston Mountains, where it reaches its lower limit on the west slope at 1,550 meters (5,100 feet), and on the Pahranagat Mountains, where it ranges down on the east slope to 1,580 meters (5,200 feet). On the Beaverdam Mountains in southwestern Utah it descends to 1,150 meters (3,800 feet) on the west slope, and to 970 meters (3,200 feet) on the east slope, thus reaching the Santa Clara Valley.

Rhus diversiloba.

Common on the west slope of the Sierra Nevada and in the Coast Ranges. It was observed along the road between Walker Basin and Caliente, and also in the Cañada de las Uvas.

Dalea polyadenia.

This small, glandular, strongly scented, purple-flowered species of *Dalea* is common over many of the desert valleys of the southern part of the Great Basin, where it was noted in the following localities:

CALIFORNIA.

Mohave Desert.—Common in places; seen in Leach Point Valley.

Owens Valley.—Common in places in the lower parts of the valley, particularly between Owens Lake and Haway Meadows.

Deep Spring Valley.—Occurs in company with *D. fremonti*, *Grayia*, *Menodora*, and a few other shrubs.

NEVADA.

Fish Lake Valley.—Tolerably common on the southeast side of the valley and ranging up to an altitude of 1,765 meters (5,800 feet).

Grapevine Cañon.—Tolerably common in the bottom of the cañon near Sarcobatus Flat.

Sarcobatus Flat.—Rather common in places in the northern part of the flat.

Oasis Valley.—A single bush seen.

Pahranagat Valley.—Common at the extreme south end of the valley in company with the large blue-flowered species (*D. fremonti*), and extends thence northerly over the gravel soil and lower gravel slopes up to 1,340 or 1,370 meters (4,400–4,500 feet). In full flower May 22–26.

Great Bend of Colorado River.—Common; in flower May 4.

Muddy Mountains.—Rather common; in full flower May 5.

Dalea fremonti.

The *Daleas* rank among the most characteristic and, when in flower, among the most beautiful and showy of the desert brush. Some doubt attaches to the determination of the species observed by Mr. Bailey and myself. The large blue-flowered species believed to be *Dalea fremonti* was noted at the following localities:

CALIFORNIA.

Mohave Desert.—Common in places; noted in Leach Point Valley.

Owens Valley.—Common along the west side of the valley from Lone Pine to Olancha, and less common south to Haway Meadows. From the east side of Owens Valley it ranges up on the west slope of the White Mountains to 1,980 meters (6,500 feet).

Deep Spring Valley.—Found in company with *D. polyadenia*, *Grayia*, and other bushes of the upper division of the Lower Sonoran Zone.

NEVADA.

Fish Lake Valley.—Common in the southeast corner of the valley, whence it ranges up to an altitude of 1,765 meters (5,800 feet).

Gold Mountain.—Common on the north slope of Gold Mountain a little below 2,135 meters (7,000 feet) in altitude.

Indian Spring Valley.—Common in the *Larrea* in the north arm of Indian Spring Valley.

Pahranagat Valley.—This large blue-flowered species was found in company with the small purple-flowered *Dalea polyadenia*, and with *Coleogyne ramosissima*, on the gravel divide at the extreme south end of the valley, south of Pahranagat Lake, at an altitude of 1,155 meters (3,800 feet). Like *Coleogyne*, it stops about half a mile north of this divide and does not occur in Pahranagat Valley proper. It does occur, however, also in company with *Coleogyne*, on the west side of the valley on the gavel slope at the east foot of the Pahranagat Mountains, between 1,280 and 1,370 meters (4,200 and 4,500 feet), but is rather scarce there. It was in full flower May 22–26.

Dalea johnsoni.

Specimens of the large and showy *Dalea johnsoni* were collected near St. George, in the Lower Santa Clara Valley, Utah; and the species was common from the Santa Clara Valley (altitude 970 meters, or 3,200 feet) up to 1,090 meters (3,600 feet) on the east slope of the Beaverdam Mountains.

Robinia neomexicana.

This dwarf locust was found in the Santa Clara Valley, in Utah, and thence up along the east slope of the Beaverdam Mountains to 1,040 meters (3,400 feet), but was not observed elsewhere.

Cassia armata.

This handsome *Cassia* was found flowering abundantly at the Great Bend of the Colorado River (May 4), in Leach Point Valley (April 25), and near the south end of Death Valley (April 26).

Cercis occidentalis.

The Judas bush was found in but one spot in the Great Basin, namely, the Charleston Mountains, Nevada, where Mr. Bailey and I found it flowering in profusion in a rocky cañon a little east of Mountain Spring, April 30. The seed pods of the previous year were still clinging to the branches, together with the handsome red flowers. On the west slope of the Sierra Nevada, in California, it was found in Kern Valley as low down as 820 meters (2,700 feet) on northerly exposures.

Prosopis juliflora.

The two species of mesquite are commonly ranked as trees and are the only trees besides cottonwoods that inhabit the arid Sonoran deserts of the Great Basin. The cottonwoods are never found except near water; the mesquite, on the other hand, occur at long distances from visible water and often occupy the tops of sand dunes. They usually grow in clumps from 3 to 9 meters (10 to 30 feet) in height. Their roots are very long and are said to travel 30 meters (100 feet) or more in search of moisture. The two species occur either together or singly, and their fruit, called 'mesquite beans,' is much sought after by the native animals and birds of the region, and also by the Indians. The pods are sweet and nutritious, and are sometimes gathered and fed to horses and mules instead of grain. The present species (***Prosopis juliflora***) was observed at the following localities:

CALIFORNIA.

Hot Springs, Panamint Valley.—Tolerably common.

Death Valley.—Occurs in clumps and irregular patches on the west side of the valley, beginning several miles south of Mesquite Well and ranging thence northward. It is abundant also on sand dunes in the northwest arm of Death Valley, from which circumstance the place is commonly known as 'Mesquite Valley.' In Death Valley it was just coming into leaf on clayey soil April 10, while adjoining clumps on sand soil were in full leaf at the same date.

Amargosa Cañon.—Common in places.

Resting Spring.—Tolerably common.

NEVADA.

Ash Meadows.—Common.

Indian Spring Valley.—Common in a few places.

Virgin and Lower Muddy Valleys.—Common in many places. (In full flower May 6.)

Great Bend of the Colorado.—Abundant on the sand hills on the south side of Vegas Wash.

UTAH.

Santa Clara Valley.—Occurs sparingly on sandy soil in the lower valley.

Prosopis pubescens.

This mesquite, commonly known as 'screw bean,' is widely distributed over the deserts of the southwest, usually in company with the preceding. It was noted in the following localities:

CALIFORNIA.

Panamint Valley.—Common about Hot Springs.

Death Valley.—Common along the west side of the valley.

Amargosa Cañon.—Occurs with *P. juliflora* and is enormously abundant in the upper part of the cañon, where Tecopa Cañon comes in.

NEVADA.

Ash Meadows.—Abundant.

Virgin and Lower Muddy Valleys.—Common in places.

Indian Spring Valley.—Occurs in places.

UTAH.

Santa Clara Valley.—Occurs sparingly on sandy soil in the lower valley.

Acacia greggii.

This Lower Sonoran shrub, which grows to be 2½ to 3 meters (8 to 10 feet) in height, perhaps higher, was not found in California, or in Nevada west of the Charleston Mountains. It is tolerably common along the upper and lower Cottonwood Springs at the east foot of the Charleston Mountains, and thence easterly was found at Bitter Springs in the Muddy Mountains, and in the valley of the Virgin and Lower Muddy, and thence northerly to the mouth of Beaverdam Creek, in northwestern Arizona, where it was abundant on the flat at the junction of Beaverdam Creek with the Virgin.

Prunus fasciculata.

This species is so characteristic of the desert ranges in the southern part of the Great Basin that it might properly be called the 'Desert Range Almond.' It is known to the Mormons as the wild almond and grows in dense clumps of bushes about as high as a man's head or lower, with irregular and very tough branches. It was noted in the following localities:

CALIFORNIA.

White Mountains.—Found in places along the summit and in cañons.

Walker Pass and Kern Valley.—Occurs sparingly, descending as low as 820 meters (2,700 feet) on northerly exposures in Kern Valley.

NEVADA.

Mount Magruder.—Not common, but found in the upper part of Tule Cañon and in a few other places.

Gold Mountain.—Tolerably common on the north slope in scattered clumps a little below 2,135 meters (7,000 feet).

Highland Range.—Occurs sparingly, mixed with *Artemisia tridentata.*

Pahroc Mountains.—Tolerably common, mixed with sagebrush and *Kunzia.*

Juniper Mountains.—Rather common, mixed with sagebrush and juniper, beginning at an altitude of about 1,830 meters (6,000 feet) on the Meadow Valley side and ranging up to the divide.

Charleston Mountains.—Common, reaching its lower limit on the west slope (Pahrump Valley side) at about 1,435 meters (4,700 feet).

UTAH.

Beaverdam Mountains.—Common, ranging down on the west slope to about 1,160 meters (3,800 feet) and on the east slope to about 1,100 meters (3,600 feet).

Santa Clara Valley.—Occurs in scattering patches on the rocky hillsides in the Upper Santa Clara Valley, beginning about 13 kilometers (8 miles) northwest of St. George at an altitude of 1,280 meters (4,200 feet) and ranging thence northerly to the Upper Santa Clara Crossing.

Prunus virginiana (or demissa).

The chokecherry grows sparingly about Sheep Spring in the Juniper Mountains between Panaca, Nevada, and Hebron, Utah, but was not observed elsewhere.

Prunus andersoni.

This species was found on the west slope of Walker Pass in the southern Sierra Nevada, California, at an altitude of about 1,370 meters (4,500 feet).

Basilima millefolium.

This beautiful shrub was observed on the Beaverdam Mountains in southwestern Utah, and on the east slope of the High Sierra in California, where it was abundant at and a little below 2,900 meters (9,500 feet).

Holodiscus discolor.

Found on the east slope of the Sierra Nevada in California at an altitude of about 2,130 meters (7,000 feet).

Adenostoma fasciculatum.

The California chemisal or chemise does not enter the desert region of the Great Basin, though it occurs on the north or Mohave Desert slope of the Sierra Liebre and throughout Cajon Pass in the San Bernardino Mountains. It is the prevailing chaparral of the coast ranges of southern California and is generally mixed with scrub oaks and *Ceanothus*, forming impenetrable thickets. It is abundant on the west slope of the Sierra Nevada on the east side of the upper San Joaquin Valley. On the north slope of the Sierra Liebre it begins a little north of Alamo ranch at an altitude of 730 meters (2,400 feet), whence southward it is the prevailing chaparral. It was in flower in the Sierra Liebre the last week in June.

Kunzia glandulosa [= *Purshia glandulosa*].

Mr. Coville tells me that this is the species found by us on the summit of Walker Pass in the southern Sierra Nevada, and thence down on the west slope to 940 meters (4,100 feet).

On the east slope of the Beaverdam Mountains (which cross the boundary between Utah and Arizona) Mr. Bailey and I collected a form very close to *K. glandulosa*, and also the typical *K. tridentata*, apparently at different altitudes. Some of the records under the latter species may belong to the former.

Kunzia tridentata [= *Purshia tridentata*].

Kunzia tridentata is common on many of the desert ranges, where it usually grows in company with *Cowania mexicana* and *Fallugia paradoxa*. When not in flower these three genera resemble one another so closely that they are sometimes confounded. *Kunzia* has yellow flowers on very short peduncles; *Fallugia* has pure white flowers on very long peduncles; *Cowania* has handsome cream-colored flowers on moderate peduncles. It is possible that the two species of *Kunzia* (*K. tridentata* and *K. glandulosa*) have been confounded in some of the following localities:

CALIFORNIA.

White Mountains.—Common on the east slope, ranging down to 1,700 meters (5,600 feet) on the Fish Lake Valley side.

NEVADA.

Mount Magruder.—Common in places, ranging down into Tule Cañon.

Gold Mountain.—Common, ranging down on the south side nearly as low as sagebrush (a little above 1,860 meters or 6,100 feet).

Hungry Hill Summit.—Common just north of the summit, whence it ranges over the divide (1,760 meters or 5,800 feet) and passes south toward the north arm of Indian Spring Valley to about 1,520 meters meters (5,000 feet).

Timpahute and Desert mountains.—A little was seen near Mud or Summit Spring.

Pahranagat Mountains.—Common, ranging down to 1,580 meters (5,200 feet) on the east slope.

Hyko Mountains.—Common in places, descending into the broad wash that leads from Pahroc Plain into the middle of Pahranagat Valley.

Pahroc Mountains.—Common, mixed with *Cowania mexicana*, *Artemisia tridentata*, and *Prunus fasciculata*.

Juniper Mountains.—Common in the juniper forest between Meadow Creek Valley, Nevada, and Shoal Creek, Utah, where it was just coming into flower May 18. A week earlier (May 10–11) it was past flowering in the Beaverdam Mountains.

UTAH.

Upper Santa Clara Valley.—Common from an altitude of 1,640 meters (5,400 feet) upwards to 1,830 meters (6,000 feet), and ranging thence northward to the Upper Santa Clara Crossing and Shoal Creek. Mostly past flowering in the Upper Santa Clara Valley May 17.

Beaverdam Mountains.—Common, descending to 1,280 meters (4,200 feet) on the east or northeast slope, and ranging down on the west slope to 1,340 meters (4,400 feet). Past flowering and petals all off May 11.

Coleogyne ramosissima.

This important zone plant grows in the *Grayia* belt just above the upper limit of the *Larrea;* it belongs therefore to the upper division of the Lower Sonoran Zone. The altitude which it requires takes it out of most of the desert valleys and places it on the sides of the desert ranges, where it commonly grows in a narrow belt between the creosote bush (*Larrea tridentata*) and the sage (*Artemisia tridentata*).

It is a low, dark-colored bush bearing small yellow flowers. The following notes respecting the details of its distribution were recorded:

CALIFORNIA.

Owens Valley.—Common along the west side of the valley on the lower slope of the Sierra Nevada, between the altitudes of 1,375 and 1,900 meters (4,500 and 6,200 feet).

Panamint Mountains.—On the west slope of the Panamint Mountains, in a broad basin above Wild Rose Spring, a well-defined zone of *Coleogyne* crosses the basin obliquely between the upper edge of the *Larrea* and the southern edge of the juniper at an altitude of about 1,525 meters (5,000 feet). On the east slope of the Panamint range Mr. Bailey found it in a zone between about 1,340 and 1,710 meters (4,400 to 5,600 feet).

NEVADA.

Charleston Mountains.—Common on the west slope, beginning at the upper edge of the *Larrea* at 1,340 meters (4,400 feet) and ranging up to about 1,825 meters (6,000 feet) in the neighborhood of Mountain Spring, where it passes over the divide and descends on the east slope to about 1,200 meters (4,000 feet) with *Yucca baccata* and *Thamnosma montana.* In full bloom April 30 on the east slope of Charleston Mountains.

Hungry Hill Summit.—Begins just north of the summit, passes over it and descends the south slope toward the North Arm of Indian Spring Valley to about 1,525 meters (5,000 feet) altitude.

Timpahute and Desert mountains.—Common in the saddle between the Timpahute and Desert mountains.

Pahranagat Mountains.—Common at 1,825 meters (6,000 feet) on the west or Timpahute side and ranging thence down to 1,525 meters (5,000 feet). On the east (Pahranagat Valley) side it grows in a zone between 1,275 and 1,500 meters (4,200 and 4,900 feet).

Pahranagat Valley.—Not found anywhere on the east side of the valley proper, but common on the gravel slope on the west side, beginning 1 mile from the bottom at 1,275 meters (4,200 feet) and ranging up to 1,500 meters (4,900 feet) at the east foot of the Pahranagat Mountains. At the south end of Pahranagat Valley it comes up over the divide below the lake at 1,150 meters (3,800 feet) and stops about half a mile north of the divide. (It was not found anywhere in Meadow Creek Valley.)

UTAH.

Beaverdam Mountains.—Common on the west slope from 1,040 meters (3,400 feet) up to the summit of the pass at 1,525 meters (5,000 feet), and on the northeast slope between 975 and 1,340 meters (3,200 and 4,400 feet), and straggling still higher.

Santa Clara Valley.—Occurs on cold slopes in the Lower Santa Clara Valley, near St. George, whence it ranges up on the north side of the valley (south exposure) to 1,525 meters (5,000 feet), but is not evenly distributed.

Cercocarpus ledifolius.

The mountain mahogany is common on the higher summits of some of the desert ranges, and was recorded from the following localities:

CALIFORNIA.

Panamint Mountains.—A grove of large and handsome mountain mahogany trees occupies the bottom of a cañon above the abandoned charcoal kilns at the north base of Telescope Peak, whence straggling trees pass over the summit of the Panamint Range north of the Peak at an altitude of 2,560 meters (8,400 feet). Others were found on the north slope as high as 3,660 meters (9,300 feet).

High Sierra.—On the east (Owens Valley) slope of the High Sierra the mountain mahogany is found in abundance, and of unusually large size. West of Lone Pine it grows in a zone from 2,285 to 2,900 meters (7,500 to 9,500 feet) altitude, and many of the individual trees attain a diameter of a foot.

NEVADA.

Mount Magruder.—Common and of large size on the main peak, above 2,590 meters (8,500 feet), but not reaching summit.

UTAH.

Upper Santa Clara Valley.—Common in places on the west slope of Pine Valley Mountain.

Cercocarpus parvifolius.

Common in the chaparral on the west slope of the Sierra Nevada and on the coast ranges. It was found in abundance also in the Cañada de las Uvas and on the south slope of the Sierra Liebre, along the upper part of the valley of Peru Creek.

Cowania mexicana.

This beautiful shrub, which attains a height of 2 or 3 meters (6 to 9 feet), is common on many of the desert ranges, where it flowers in such profusion that its large cream-colored blossoms often hide the deep green of its foliage.

CALIFORNIA.

Panamint Mountains.—Found on the summit of the range, northwest of Telescope Peak, at an altitude of about 2,560 meters (8,400 feet).

NEVADA.

Mount Magruder.—Found sparingly in the upper part of the Tule Cañon on the south slope of Mount Magruder.

Gold Mountain.—Common, and ranging down on the south side to about 1,990 meters (6,200 feet).

Hungry Hill Summit.—Begins just north of the summit, passes over the divide and down on the south side, toward Indian Spring Valley, to about 1,525 meters (5,000 feet).

Pahranagat Mountains.—Common, descending to about 1,580 meters (5,200 feet) on the east slope.

Pahroc Mountains.—Common in the sage brush near Pahroc Spring; just coming into flower May 20.

Highland Range.—Found on the west slope.

Charleston Mountains.—Found on the west slope from 1,550 to 1,830 meters (5,100 to 6,000 feet) in the neighborhood of Mountain Spring.

Juniper Mountains (between Panaca, Nevada, and Shoal Creek, Utah).—Abundant in places on south exposures, where it was hardly in bud May 17, while a week earlier (May 10) it was flowering in the height of perfection on the Beaverdam Mountains. *Kunzia tridentata* was common with *Cowania* in the Juniper Mountains and was just coming into flower May 17, while it had past flowering in the Beaverdam Mountains May 10.

UTAH.

Beaverdam Mountains.—Abundant, ranging from 1,100 to 1,430 meters (3,600 to 4,700 feet) in altitude on the northeast slope; flowering profusely May 10–11.

Santa Clara Valley.—In ascending the Santa Clara Valley, *Cowania* begins in the sage brush about 13 kilometers (8 miles) northwest of St. George (altitude 1,280 meters, or 4,200 feet), and extends thence northerly to and beyond the Upper Santa Clara Crossing, reaching an altitude of about 1,645 meters (5,400 feet) where it stops and *Kunzia* begins. In other localities it is mixed with *Kunzia*, though the latter generally ranges higher.

Fallugia paradoxa.

This species occurs on many of the desert ranges of the Great Basin, often associated with *Cowania mexicana* and *Kunzia tridentata*, from which it has not always been discriminated by travelers. *Fallugia* averages hardly more than a meter in height, being a much smaller bush than *Cowania*. Its pure white flowers are larger than the cream-colored blossoms of *Cowania*, and are borne on longer peduncles. The flowers of *Kunzia* are yellow. *Fallugia* was found in the following localities:

NEVADA.

Charleston Mountains.—Common on the west slope above 1,430 meters (4,700 feet), in the neighborhood of Mountain Spring, ranging up to at least 1,700 meters (5,600 feet). On the east slope it was not seen above 1,525 meters (5,000 feet).

Pahranagat Mountains.—Common on the east slope a little above 1,580 meters (5,200 feet), and on the west slope reaches the summit.

Hungry Hill Summit.—Begins just north of summit and passes over the divide (1,770 meters, or 5,800 feet) and down on the south side toward the North Arm of Indian Spring Valley to 1,525 meters (5,000 feet).

UTAH.

Beaverdam Mountains.—Common on the east and northeast slopes of the Beaverdam Mountains, between 1,160 and 1,370 meters (3,800 to 4,500 feet), where it was just coming into flower May 11.

Rosa sp.—?

A wild rose was found in large patches in Pahranagat Valley, Nevada, where it was in full bloom May 22–25.

Heteromeles arbutifolia.

This is one of the characteristic shrubs of the Coast Ranges of California. It is common on the south slope of the Sierra Liebre, but hardly enters the region covered by the expedition.

Amelanchier alnifolia.

The service berry does not grow in the deserts, but occurs sparingly on some of the desert ranges.

In Nevada it was found on the west slope of the Charleston Mountains, between 1,675 and 1,765 meters (5,500 to 5,800 feet) altitude; on the Juniper Mountains, on the Pahroc Mountains, and on Mount Magruder, where it descends into the upper part of Tule Cañon.

In Utah it was found sparingly between the Upper Santa Clara Crossing and Mountain Meadows, and in some places formed dense thickets; and on the east slope of the Beaverdam Mountains it was common between an altitude of 1,100 meters (3,600 feet) and the summit of the pass at 1,525 meters (5,000 feet).

Peraphyllum ramosissimum.

This dwarf cherry, whose handsome flowers are disproportionately large for so small a bush, was found in the following localities on the mountain sides of the Transition Zone.

NEVADA.

Mount Magruder.—Very abundant in large patches from an altitude of about 2,130 meters (7,000 feet) up to about 2,590 meters (8,500 feet) and descending into Tule Cañon. Flowering profusely June 6.

Charleston Mountains.—Found near Mountain Spring.

Hungry Hill Summit.—Begins a little north of the summit, passes over the divide (1,760 meters, or 5,800 feet) and down on the south side toward the North Arm of Indian Spring Valley to about 1,525 meters (5,000 feet).

Highland Range.—Found on the west slope.

Juniper Mountains.—Found in scattered clumps at an altitude of about 1,825 meters, (6,000 feet) and upwards from the Upper Santa Clara Crossing to Shoal Creek and thence northwesterly across the Juniper Plateau.

Ribes leptanthum brachyanthum.

This species was collected on Gold Mountain, Nevada, at an altitude of about 2,130 meters (7,000 feet).

Others, probably the same species, were found at Sheep Spring in the Juniper Mountains, Nevada; in the cañon at the south end of Pahranagat Valley, and on Mount Magruder.

Ribes menziesii.

Common in places in the Cañada de las Uvas, California, especially in the vicinity of Old Fort Tejon.

Petalonyx parryi.

This bush was found in but one locality, namely, the mesa on the south side of Vegas Wash, Nevada, where it was abundant on gypsum soil and in full bloom May 2. It is a small bush averaging 450 to 600^{mm} (about 1½ or 2 feet) in height, and having pale, yellowish flowers.

Eucnide urens.

This singular plant, which grows in crevices in rocky cañons, was found in suitable places along the bases of many of the desert ranges in southern California and western Nevada, and also along the Lower Santa Clara River in southwestern Utah.

Garrya veatchii flavescens.

This willow-like bush, about 1½ meters (5 feet) in height, is common on the west slope of the Charleston Mountains, Nevada, near Mountain Spring, between 1,670 and 1,760 meters (5,500 and 5,800 feet), and on the Beaverdam Mountains in southwestern Utah.

Symphoricarpos longiflorus.

Symphoricarpos bushes were found on many of the desert ranges of Nevada, in the Upper Sonoran and Transition zones. *S. longiflorus* was common at Pahroc Spring, where it was in full flower May 21 (specimens collected). Others, supposed to belong to the same species, but not collected and not positively identified, were recorded from the following localities:

NEVADA.

Highland Range.—Common in places, particularly in cañons.

Timpahute and Desert mountains.—Common in places on the higher parts of the range.

Hyko Range.—Found sparingly in a cañon leading from Pahroc Plain to Pahranagat Valley.

Pahranagat Mountains.—Common, descending on the east slope to 1,580 meters (5,200 feet).

Gold Mountain.—Common on the north side.

Mount Magruder.—Common high up on the main peak and on side hills lower down, and also in several of the cañons, particularly in the upper part of Tule Cañon.

UTAH.

Beaverdam Mountains.—Found on the east slope.

Amphiachyris fremontii.

This handsome little bush, which is common on parts of the Mohave Desert, was collected in the Valley of the Virgin near Bunkerville, Nevada.

Acamptopappus sphærocephalus.

This composite desert shrub is abundant on many of the deserts and was common in the narrow valley between Owens Lake and Haway Meadows, California.

Aplopappus monactis.

Collected on Sarcobatus Flat, on the southwestern edge of the Ralston Desert, Nevada.

Bigelovia douglassi.

This species is not found in the desert bottoms, but is common among the sage brush and junipers on many of the mountain sides.

CALIFORNIA.

Walker Pass.—Becomes abundant at an altitude of 1,430 meters (4,700 feet) on the east side and ranges up over the summit of the pass. On the west side it descends plentifully to 1,250 meters (4,100 feet).

Kern Valley.—Occurs on the north exposures as low down as 820 meters (2,700 feet).

Tehachapi Basin.—Occurs.

Cañada de las Uvas.—Common.

Bigelovia graveolens.

This Upper Sonoran desert species was common in the extreme western end of the Mohave Desert (Antelope Valley) and was found in a wash leading thence southerly toward Peru Creek, along with tree yuccas, sage brush, and *Isomeris*. Specimens provisionally referred to the same species by Mr. Coville were collected at Beaverdam, Arizona.

Bigelovia teretifolia.

Collected on Gold Mountain, Nevada, at an altitude of 1,830 meters (6,000 feet) June 3.

A large and rank species, supposed to be the same, was found in abundance in many of the dry washes of the desert ranges from Emigrant Cañon in the Panamint Mountains, California, eastward to the Pahranagat and Hyko ranges, Nevada, and the Beaverdam Mountains, Utah. On the west slope of the latter range it was found up to 1,340 meters (4,400 feet).

Baccharis glutinosa.

No species of *Baccharis* was observed on the western side of the Great Basin, but one or more species were found in great abundance at the Bend of the Colorado River, in Nevada, and in the Valley of the Virgin and Lower Muddy, and also on the flat at the mouth of Beaverdam Creek, in northwestern Arizona.

Pluchea sericea.

This slender, willow-like plant, sometimes called 'arrow-wood,' forms low thickets in the neighborhood of water in some parts of the desert region, but was not found west of Death Valley. It is common at Furnace Creek on the east side of Death Valley, the only locality in California where it was seen by the expedition. In Nevada it is common about some of the warm springs in Ash Meadows, and very abundant in Vegas Wash and about the Great Bend of the Colorado River, and also in parts of the Muddy and Virgin valleys. In the Lower Santa Clara Valley, Utah, near the junction of the Santa Clara with the Virgin, it forms dense thickets along the river.

Hymenoclea salsola.

This small shrub, which suggests a *Bigelovia* in general appearance, but is profusely beset with small glomerate heads, is common in many parts of the desert region, particularly along the courses of washes on the mountain sides, in which it frequently attains a considerable altitude. The following notes on its distribution were recorded:

CALIFORNIA.

Mohave Desert.—Common in places and found as far west as Antelope Valley, between the town of Mohave and Willow Spring; also extends up the open cañon leading from Mohave to Tehachapi Basin, where it reaches an altitude of 1,050 meters (3,450 feet).

Walker Pass.—On the east side of the pass it ranges up to 1,430 meters (4,700 feet) in the tree yuccas. On the west side of the pass it runs down into Kern Valley as low as 820 meters (2,700 feet), perhaps lower.

Owens Valley.—Abundant in the southern part of the valley and one of the commonest shrubs on the west side between Lone Pine and Haway Meadows. It ranges up along the foot of the Sierra slope to 1,525 or 1,550 meters (5,000 or 5,100 feet).

Deep Spring Valley.—Found in the wash leading up to the pass across the White Mountains.

NEVADA.

Grapevine Cañon.—Common in the bottom of the cañon.

Oasis Valley.—Common along the bottom of the valley.

Indian Spring Valley.—Common in the wash at the extreme west end of Indian Spring Valley.

Emigrant Valley.—Common and reaching thence up on the west side of the Desert Mountains to about 1,680 meters (5,500 feet) near Mud or Summit Spring.

Timpahute Valley.—One of the principal plants in the bottom.

Pahranagat Valley.—Common throughout the dryer parts of the valley up to about 1,340 meters (4,400 feet). On the west side (Pahranagat Mountain slope) it runs up a gravel wash to nearly 1,525 meters

(5,000 feet). On the east side it is common in a wash leading down from Pahroc Plain through the Hyko Mountains.

Virgin Valley.—Common in places.

UTAH.

Beaverdam Mountains.—Reaches up the west slope of the Beaverdam Mountains to 1,340 meters (4,400 feet).

Santa Clara Valley.—Common over most of the valley, reaching upon the east slope of the Beaverdam Mountains to 1,100 meters (3,600 feet).

Franseria dumosa.

This small and inconspicuous shrub is one of the most important zone plants of the Lower Sonoran Zone, because of its wide distribution and strict adherence to the lower division of this zone. It occurs almost invariably in company with *Larrea tridentata*. The following notes on its distribution were recorded:

CALIFORNIA.

Mohave Desert.—Abundant, finding its upper limit on the north side of the desert at about 1,000 meters (3,250 feet), where it enters the mouth of the open cañon leading from Mohave to Tehachapi, and ranges about 45 meters (150 feet) higher than *Larrea*. It reaches its western limit in Antelope Valley.

Walker Pass.—Common at the east mouth of Walker Pass, ranging up to about 1,100 meters (3,600 feet) thus exceeding the *Larrea* by about 30 meters (100 feet).

Owens Valley.—Common in the extreme south end of the valley on the east side, and found in scattered patches from Lone Pine south, and all along the west side of Owens Lake and thence south to Haway Meadows.

NEVADA.

Pahrump Valley.—Common in the *Larrea* on the east side of the valley, where it finds its upper limit with that of *Larrea* on the southwest slope of the Charleston Mountains at 1,310 meters (4,400 feet).

Vegas Valley.—Covers the valley with *Larrea* and ranges up on the west side to about 1,130 meters (3,700 feet).

Muddy Mountains.—Common in *Larrea* at the Great Bend of the Colorado whence it extends northward over the low summits of the Muddy Mountains between Callville and the Virgin.

Valley of the Virgin and Lower Muddy.—Abundant in dry places with *Larrea*, particularly on gravel slopes. Common also on the high mesa between these two rivers, where it is abundant along the boundary between Arizona and Nevada.

Pahranagat Valley.—Common on the gravel benches with *Larrea* in the southern and southwestern parts of the valley, but not evenly distributed and not reaching the northern part of the valley at all. It runs up an open cañon leading from Pahroc Plain into Pahranagat Valley, reaching an altitude of 1,310 meters (4,300 feet) on the southwesterly slope exposures, but falling a little short of the extreme limit of the scattered patches of *Larrea* in the same cañon.

Indian Spring Valley.—Common throughout the valley in *Larrea*.

Oasis Valley.—Occurs sparsely in the lower part of the valley along with *Larrea*, both species here finding their northern limit in this part of Nevada.

Grapevine Cañon.—*Franseria* comes up in Grapevine Cañon from Death Valley and reaches up on the southern slope of Gold Mountain as high as 1,610 meters (5,300 feet) in company with *Larrea*. (It was not found in Sarcobatus Flat or in Meadow Creek Valley.)

ARIZONA.

Common with *Larrea* in the Valley of the Virgin near the mouth of Beaverdam Creek, and ranging thence easterly up the west slope of the Beaverdam Mountains to 1,160 meters (3,800 feet).

UTAH.

Santa Clara Valley.—Occurs sparingly in the lower part of the valley, disappearing a little above 1,220 meters (4,000 feet).

Franseria eriocentra.

This species was first found at the mouth of Beaverdam Creek in northwestern Arizona. On the opposite side of the mountains it is common in parts of the Santa Clara Valley in Utah. In Nevada it is abundant in the higher parts of Pahranagat Valley, whence it ranges up through a cañon in the Hyko Mountains; it reaches the summit of the pass over the Pahranagat Mountains (1,825 meters or 6,000 feet) from the west (Timpahute) slope; and occurs also at Hungry Hill Summit, whence it extends southerly to about 1,675 meters (5,500 feet).

Encelia frutescens.

This species is common in places on the Mohave Desert, whence it ranges up completely through the open cañon leading from Mohave to Tehachapi Valley (altitude of divide 1,100 meters or 3,600 feet), and up the east slope of Walker Pass to 1,430 meters (4,700 feet).

Artemisia tridentata.

This species, the true aromatic sagebrush of the Great Basin, does not grow anywhere in the deserts of the Lower Sonoran zone, but begins with the Upper Sonoran and ranges thence northward over the plains of the Transition zone, and on many mountain sides covers the gravel slopes well up into the Boreal. In the southern part of the Great Basin, therefore, it was found only on the mountains. Coming down from the plains of Oregon, Washington, and Idaho, it covers the whole of the northern part of the State of Nevada, and California east of the Sierra Nevada, and reaches southward uninterruptedly along the bottom of Owens Valley nearly to Owens Lake, and still further south along the Sierra, White, and Inyo mountains. On the treeless plains it is much prized as firewood. The following detailed notes on its distribution were recorded:

CALIFORNIA.

Cañada de las Uvas.—Common at an altitude of 1,070 meters (3,500 feet), ranging from Castac Lake eastward to the extreme west foot of Antelope Valley and also occurring in a wash leading thence southward toward Peru Creek, where it is mixed with stunted tree yuccas (altitude 760 to 910 meters or 2,500 to 3,000 feet).

Walker Pass.—Common on the east side of the pass from 1,430 meters (4,700 feet) to summit (1,550 meters or 5,100 feet), and much higher on mountains on both sides. On the west slope it covers the whole pass down to 1,240 meters (4,100 feet).

Kern Valley.—Found on a steep north slope in the Kern River Valley as low as 820 meters (2,700 feet).

East slope of Sierra Nevada.—Abundant all along the west side of Owens Valley and ranging thence up on the Sierra as high as 2,740 meters (9,000 feet).

Owens Valley.—Covers the whole valley from its northern end down to within a few miles of Lone Pine, descending to about 1,160 meters (3,800 feet). South of Lone Pine it is confined to the west side of the valley, where it follows the cold streams that come down from the High Sierra and is common on the slope above 1,550 meters (5,100 feet). In a few places it reaches the narrow valley between Owens Lake and Haway Meadows. It is absent from the warm slope at the foot of the White and Inyo mountains on the east side of Owens Valley, but begins as low as 1,980 meters (6,500 feet) on northerly exposures in the latitude of Big Pine, and ranges up over the White Mountains.

White and Inyo mountains.—Abundant over most parts of the summit of the range, often forming pure sage plains of considerable extent and ranging down to about 2,280 meters (7,500 feet) on the west slope (Owens Valley side) and to 1,920 meters (6,300 feet) on the east slope (Deep Spring Valley side), but does not descend into Deep Spring Valley.

Panamint Mountains.—Common along the summit of the range, descending as low in places as 1,980 meters (6,500 feet) or even 1,920 meters (6,300 feet). On the west slope of Telescope Peak it grows as high as 3,050 meters (10,000 feet).

Mohave Desert.—Found on the summit of Cajon Pass and thence along the upper part of the Mohave Desert at the foot of the San Bernardino Mountains, occurring sparsely among the junipers down to an altitude of 1,160 meters (3,800 feet), where it is replaced by *Atriplex* and other genera. The altitude of the Mohave Desert as a whole is too low for sagebrush.

NEVADA.

Fish Lake Valley.—Not found in the bottom of the valley, but descends from the White Mountains to about 1,680 meters (5,500 feet) along the west side of the valley; and from Mount Magruder to about 2,040 meters (6,700 feet) on the southeast side of the valley (northwest exposure), and still lower on northerly exposures.

Mount Magruder.—Covers the whole Mount Magruder plateau and the hills and peaks that rise from it even to the extreme summit of Mount Magruder itself. On the latter peak it grows in a peculiar way, forming distinct lines that are conspicuous at a distance. These lines are horizontal on the peaks and vertical on the saddles. On the south side of Mount Magruder it descends into Tule Cañon (in the upper part of which it is the prevailing brush) and into the valley between Mount Magruder and Gold Mountain, where it is mixed with *Grayia spinosa*, *Tetradymia glabrata*, *Atriplex confertifolia*, and other species. On the northwest slope of Mount Magruder it descends to Pigeon Spring (altitude 2,040 meters, or 6,700 feet) and reaches several hundred feet lower on the south side of the cañon (north exposure).

Gold Mountain.—Sagebrush is the prevailing brush on Gold Mountain, on the south slope of which it descends to 1,830 meters (6,000 feet).

Timpahute and Desert ranges.—Common along the summit, descending to the divide at Hungry Hill summit, 1,780 meters (5,850 feet), and extending thence southward toward the North Arm of Indian Spring Valley to 1,740 meters (5,700 feet), and northward toward Emigrant Valley to 1,700 meters (5,600 feet).

Pahranagat Mountains.—Abundant, descending as low as 1,525 meters (5,000 feet) on the east slope (Pahranagat Valley side) at the latitude of the middle of the valley, and still lower in the northern part of the valley.

Pahroc Mountains.—Common, reaching down to 1,740 meters (5,700 feet) or a little lower on the upper levels of Desert Valley.

Highland range.—Abundant, descending to 1,830 meters (6,000 feet) on the west side (Desert Valley side), and down into the valley of Meadow Creek on the east side, covering the valley excepting the flat bordering the creek.

Juniper Mountains.—The whole of the high plateau here spoken of as the Juniper Plateau or Mountains, extending from Meadow Creek Valley, Nevada, easterly to and across the western boundary of Utah, is continuously covered with sagebrush mixed with junipers.

Charleston Mountains.—Abundant throughout the higher parts of the Charleston Mountains, descending on the west slope (Pahrump Valley side) to 1,550 meters (5,100 feet).

UTAH.

In western Utah the true sage spreads southward continuously, covering the Escalante Desert and Shoal Creek country and Mountain Meadows (which is a true sage plain), and extending south continuously far enough to include the Upper Santa Clara Valley above 1,280 meters

(4,200 feet) altitude, where its southern edge reaches within 13 kilometers (8 miles) of the town of St. George. To the west it ranges continuously over the Juniper Plateau to Meadow Creek Valley as already mentioned, and reaches southward along the Beaverdam Mountains, descending to 1,340 meters (4,400 feet) on the west (Arizona) slope and to 1,100 meters (3,600 feet) on the east (Utah) slope.

Artemisia spinescens.

This compact little species is abundant on many of the higher valleys and slopes of the desert region in the southern part of the Great Basin, in California and Nevada. The following notes on its distribution were recorded:

CALIFORNIA.

Walker Pass.—Found on the summit at an altitude of 1,830 meters (6,000 feet).

Deep Spring Valley.—Common, in company with *Menodora spinosa*, *Grayia spinosa*, *Eurotia lanata*, *Dalea fremonti*, *D. polyadenia*, *Lycium andersoni*, and *Tetradymia spinosa*.

Panamint Mountains.—Common in many parts of the range. The little basin between Wild Rose Spring and Emigrant Cañon, named 'Perognathus Flat' by our expedition, is covered with this species, very pure and little mixed with other plants.

NEVADA.

Fish Lake Valley.—Abundant, covering the flat on the east side of the valley in company with *Eurotia lanata*, and ranging thence up on the northwest slope of Mount Magruder nearly to Pigeon Spring (altitude 2,040 meters or 6,700 feet).

Valley between Mount Magruder and Gold Mountain.—Not abundant, but found in company with *Artemisia tridentata*, *Grayia spinosa*, *Atriplex confertifolia*, and *Tetradymia glabrata*.

Grapevine Cañon.—Tolerably common in the upper part of the cañon.

Sarcobatus Flat.—Common in northern part.

Oasis Valley.—Common in the upper part of the valley above 1,220 meters (4,000 feet) and ranging thence westerly.

Emigrant Valley.—One of the commonest plants of the bottom (altitude a little above 1,525 meters or 5,000 feet), and ranging thence easterly up on the Timpahute Mountains to 1,680 meters (5,500 feet).

Timpahute Valley.—One of the principal plants.

Pahranagat Valley.—Common on the higher levels above 1,220 meters (4,000 feet). In places on the west side of the valley it reaches 2,440 meters or 5,300 feet (on the east slope of the Pahranagat Mountains).

Desert Valley.—The dominant plant in the gravelly soil surrounding the dry lake.

Meadow Creek Valley.—Common below 1,770 meters (5,800 feet), on the west slope of the Juniper Plateau.

Artemisia arbuscula.

This sage, which grows at greater elevations than most species, was found in Nevada on the summit of the Pahranagat Mountains and on Mount Magruder.

Artemisia filifolia.

This species was rare in the region traversed, but was found covering a large flat near St. George in the Lower Santa Clara Valley, Utah. It differs widely from the other species of the genus, its long linear or filiform whitish leaves giving it a peculiarly soft and beautiful appearance.

Peuceaphyllum schottii.

This large shrub, resembling a *Bigelovia* in general aspect, was found in many of the dry washes on the lower parts of the desert ranges and in some of the higher valleys. It is common in Owens Valley, California, where it ranges up on the east slope of the Sierra to 1,550 meters (about 5,100 feet). On the opposite side of the valley it reaches up on the west slope of the White Mountains to about 1,980 meters (6,500 feet). It is common also on the Panamint Mountains, California, in the Muddy Mountains, Nevada, and in many other localities.

Tetradymia canescens.

This species is common on many of the higher levels, particularly on the desert ranges. In Nevada it was common on Mount Magruder; in the upper part of Pahranagat Valley; in the Juniper Mountains (between Meadow Creek, Nevada, and the Escalante Desert, Utah); and in Utah in the upper part of the Santa Clara Valley (mixed with the true sage brush, *Artemisia tridentata*).

Tetradymia glabrata.

This fine species was not seen in the southern deserts traversed in going from Panamint and Death valleys across southern Nevada to Utah, but was found in a number of places on the return trip, which was a little further north and covered higher ground. Before going to seed it may be easily recognized by its deep-green cylindrical branches, which are nearly vertical. It was found between the east slope of the Sierra in Owens Valley, California, and Meadow Creek Valley, Nevada, in the following localities:

CALIFORNIA.

Owens Valley.—Common, ranging up to 1,550 meters (5,100 feet) on the west slope.

NEVADA.

Valley between Gold Mountain and Mount Magruder.—Occurs sparingly in this valley with *Artemisia tridentata*, *Grayia spinosa* and other brush.

Grapevine Cañon.—Found in the upper part of the cañon.

Sarcobatus Flat.—Tolerably common in places in the northern part of the flat.

Oasis Valley.—Scarce. Found sparingly above 1,200 meters (4,000 feet).

Emigrant Valley.—Common on the higher slopes and ranging thence easterly over the west slope of the Desert Mountains.

Timpahute Valley.—One of the principal plants ranging easterly to the summit of the pass over the Pahranagat Mountains (1,830 meters or 6,000 feet.)

Pahranagat Valley.—Tolerably common in dry places, running up to 1,650 meters (5,400 feet) on the west side of the valley (Pahranagat Mountain side) with *T. spinosa* and *Grayia spinosa*. Some of it was in full flower May 22–26, though it was mostly in bud at that date.

Desert Valley.—Ranges throughout the low pass across the Highland Range between Meadow Creek and Desert valleys.

Meadow Creek Valley.—Common, ranging easterly for about 13 kilometers (8 miles) east of Panaca, where it was first seen. This point constitutes the easternmost limit of the range of the species so far as observed by us.

Tetradymia spinosa.

This elegant bush, with conspicuous long straw-yellow spines, is common on many of the higher levels in the southern part of the Great Basin. In early spring when the foliage is freshest it is very handsome, and later in the season when in fruit and covered with its white woolly tufts of soft feathery plumes it is still more beautiful. It was found in the following localities:

CALIFORNIA.

Walker Pass.—Tolerably common among the tree yuccas on the east side of the pass as high up as 1,430 meters (4,700 feet); found also on the west slope between 1,250 and 1,400 meters (4,100 and 4,600 feet).

Kern Valley.—Common on northerly exposures as low as 820 meters (2,700 feet).

Owens Valley.—Common along the west side of the valley, where it ranges up the east slope of the Sierra opposite Lone Pine to 1,830 or 1,890 meters (6,000 to 6,200 feet). On the opposite side of the valley it ranges up the White Mountain slope to 1,980 meters (6,500 feet) or higher.

Deep Spring Valley.—Occurs in the bottom of the valley with *Grayia spinosa*, *Menodora spinosa*, *Eurotia lanata*, *Daleas*, and a few others (altitude about 1,675 meters or 5,500 feet).

NEVADA.

Gold Mountain.—Common on the south slope above 1,675 meters (5,500), and on the north slope below 2,135 meters (7,000 feet).

Oasis Valley.—Common on gravel soil at the head of the valley at an altitude of about 1,340 meters (4,400 feet).

Emigrant Valley.—Found on the east side of the valley, ranging thence over the lower parts of the Desert and Timpahute mountains.

Timpahute Valley.—Common on the higher levels, and ranges up on the Pahranagat Mountain slope to the summit of the divide at 1,830 meters (6,000 feet). On the west side of the valley it begins at 1,460 meters (4,800 feet) and ranges up on the Timpahute Mountains.

Pahranagat Valley.—Common in places, generally on gravel soil, ascending on the west side of the valley (east slope of Pahranagat Mountains) to 1,645 meters (5,400 feet).

Highland Range.—Found sparingly on the west slope.

Charleston Mountains.—On the west slope of the Charleston Mountains *Tetradymia spinosa* was found in a zone between 1,340 and 1,765 meters (4,400–5,800 feet).

UTAH.

Beaverdam Mountains.—Occurs sparingly.

Tetradymia comosa (or stenolepis).

This beautiful shrub, which may be recognized at a distance by its whiteness, is common in part of the region traversed. It was found in the following localities:

CALIFORNIA.

Owens Valley.—Common in the higher parts of the valley, ranging up on the west side opposite Lone Pine to 1,520 or 1,550 meters (5,000 or 5,100 feet.)

Walker Pass.—Occurs on the east side of the pass where it was seen at 1,250 meters (4,100 feet).

Kern Valley.—Found on northerly exposures as low as 820 meters (2,700 feet.)

Mohave Desert.—Found in places, ranging westward nearly to Willow Spring in Antelope Valley, and extending northward through the open cañon leading from Mohave to Tehachapi.

Arctostaphylos glauca.

In Cajon Pass this manzanita begins at about 670 meters (2,200 feet) and ranges up to the summit of the pass.

Arctostaphylos pungens.

This species of manzanita was found on the Charleston Mountains, Nevada, near Mountain Spring, and on the east slope of the Beaverdam Mountains in Utah, from 1,100 to 1,300 meters (3,600 to 4,300 feet) altitude. It was not found on any of the other desert ranges.

NOTE.—Other species of manzanita are common on both slopes of the Sierra Nevada in California, and on the coast ranges.

Menodora spinescens.

The beautiful little bush provisionally referred to this species, but which may have been *Menodora scoparia*, grows in dense tufts over many of the higher desert levels, where it is easily recognized by the peculiar green of its foliage and by the circumstance that it fruits early and its large green berries are distributed in pairs along the branches, growing sessile, one on each side of the stem. It was found in the following localities:

CALIFORNIA.

Deep Spring Valley.—Occurs in company with *Grayia*, *Eurotia*, *Dalea*, *Lycium*, and *Tetradymia spinosa;* altitude about 1,680 meters (5,500 feet).

NEVADA.

Fish Lake Valley.—Common on the upper levels, ranging up on the northwest side of Mount Magruder to 1,950 meters (6,400 feet).

Gold Mountain.—Common on the south slope, ranging upward from 1,550 meters (5,100 feet).

Oasis Valley.—Occurs sparingly above 1,220 meters (4,000 feet).

Indian Spring Valley.—Tolerably common throughout the valley.

Timpahute Valley.—One of the principal plants.

Pahranagat Valley.—Rather common on gravelly soil above an altitude of 1,190 meters (3,900 feet); on the west side of the valley (Pahranagat Mountain slope) it ranges up to 1,525 meters (5,000 feet). It was heavily laden with fruit May 22–26.

Charleston Mountains.—On the west slope of the Charleston Mountains *Menodora spinosa* ranges from about 1,525meters (5,000 feet) down to the upper levels of Pahrump Valley.

NOTE.—Another species of *Menodora*, considerably larger than the one above mentioned (perhaps true *spinescens*), was found on the divide south of Pahranagat Lake, Nevada, at an altitude of about 1,150 meters (3,800 feet).

Fraxinus coriacea.

This ash was observed in the following localities:

CALIFORNIA.

Owens Valley.—Common in open groves along Cottonwood and Ash creeks on the west side of Owens Lake, where it was heavily laden with fruit June 19. Another and very distinct species occurs in company with *F. coriacea* and was in fruit on the same date.

NEVADA.

Ash Meadows.—Ash Meadows takes its name from the circumstance that this small ash is common about many of the warm springs. Ash Meadows is the type locality of the species.

Upper Cottonwood Springs.—Small ash trees, supposed to be this species, are common with the desert willows (*Chilopsis linearis*) along the Upper Cottonwood Springs at the east base of the Charleston Mountains.

UTAH.

Santa Clara Valley.—A small ash, supposed to be this species, is common along the banks of the Lower Santa Clara River, where it occurs in company with *F. anomala*, the latter reaching the Santa Clara from the neighboring slope of the Beaverdam Mountains.

Fraxinus anomala.

This single-leaved dwarf ash was found near Mountain Springs on the west slope of the Charleston Mountains, Nevada, from 1,600 to 1,760 meters (5,300 to 5,800 feet); and on the east slope of the Beaverdam Mountains, Utah, from an altitude of 1,275 meters (4,200 feet) down to the Lower Santa Clara Valley, where it occurs along the river with another species believed to be *F. coriacea*.

Eriodictyon tomentosum.

This species was common in the Cañada de las Uvas, California, particularly on north and east exposures, and was found also on the south slope of the Sierra Liebre along the Valley of Peru Creek.

Lycium andersoni.

The members of the genus *Lycium* rank among the characteristic bushes of the Great Basin in California, Nevada, Utah, and Arizona. They rarely inhabit the lower deserts, but are found plentifully on the upper levels and on many of the desert ranges. They are not social plants, but occur here and there among the other kinds of desert brush. Their flowers are usually greenish yellow and inconspicuous. The berries of *L. andersoni* are brownish in color, acid, and rather pleasant, suggesting currants. This species, which is the smallest of the genus, was found in the following localities:

CALIFORNIA.

Antelope Valley (west end of Mohave Desert).—A little was seen between Mohave and Willow Spring. It occurs also along the northwest edge of the Mohave Desert, and ascends the open cañon leading up to Tehachapi Valley as high as 1,030 meters (3,400 feet).

Walker Pass and Kern Valley.—Runs up to 1,430 meters (4,700 feet) on the east slope. On the west slope it was observed from 1,220 meters (a little over 4,000 feet) down to 820 meters (2,700 feet) in the valley of Kern River.

Owens Valley.—Occurs sparingly on the west side of the valley, ranging up to 1,525 or 1,550 meters (5,000 or 5,100 feet) on the Sierra slope opposite Lone Pine.

Deep Spring Valley.—Occurs in company with *Grayia*, *Eurotia*, *Dalea fremonti*, *D. polyadenia*, *Menodora spinosa*, *Tetradymia spinosa*, *Artemisia spinescens*, and *Atriplex canescens*.

NEVADA.

Fish Lake Valley.—Found on the east side of the valley, whence it ranges up on the northwest slope of Mount Magruder as high as 1,860 meters (6,100 feet).

Meadow Creek Valley.—Common in places, and ranging up to 1,765 meters (5,800 feet) on the west slope of the Juniper Range.

Grapevine Cañon.—Occurs at the upper end of the cañon near Sarcobatus Flat.

Oasis Valley.—Rather common, beginning at the foot of the valley at 1,140 meters (3,750 feet), and following the bottom to the head of the valley.

Amargosa Desert.—Occurs sparingly, mixed with the upper edge of the *Larrea.*

Indian Spring Valley.—Common; berries ripe May 29.

Emigrant Valley.—Common, and runs up on the west slope of the Desert Mountains to the divide near Summit or Mud Spring.

Timpahute Valley.—One of the principal plants.

Pahranagat Valley.—Common on dry gravelly levels, mixed with other shrubs. Extends up from the valley to 1,580 meters (5,200 feet) or higher on the Pahranagat Mountains. Fruit ripening May 22–26.

Pahroc Plain.—Rather common, mixed with *Grayia spinosa, Eurotia lanata,* and *Atriplex canescens.*

UTAH.

Beaverdam Mountains.—Tolerably common on the east slope, ranging up to 1,100 meters (3,600 feet), and down to the Santa Clara Valley.

Lycium cooperi.

This large species was found in the following localities:

CALIFORNIA.

Mohave Desert.—Common in the upper levels, reaching west in Antelope Valley nearly to Willow Spring, and extending northward throughout the open cañon leading up to Tehachapi.

Tehachapi Valley.—Occurs in places, coming from the Mohave Desert and extending northward sparingly into Tehachapi Pass.

Kern Valley.—Occurs on northerly exposures down to 820 meters (2,700 feet).

Owens Valley.—Common in large clumps on the west side of the valley, ranging up on the Sierra slope as high as 1,830 or 1,890 meters (6,000 or 6,200 feet) opposite Lone Pine, and common in places all the way south to Haway Meadows and the Mohave Desert.

Panamint Mountains.—Common in places.

NEVADA.

Gold Mountain.—Occurs sparingly on the north slope (collected).

Amargosa Desert.—Found mixed with the *Larrea* in the upper part of the *Larrea* zone.

Oasis Valley.—Occurs.

Mount Magruder.—Found near Pigeon Spring, on the northwest slope of Mount Magruder.

Lycium torreyi.

This large species was collected in fruit in the Muddy Valley near St. Thomas, Nevada, where it was common in dry parts of the valley, and also in the Valley of the Virgin (nearly out of flower May 6). In Utah it was found in the Santa Clara Valley.

Lycium pallidum.

This large species, which has large trumpet-shaped flowers and large leaves, is common in the Upper Santa Clara Valley, Utah, about 8 miles northwest of St. George, at an altitude of 1,275 meters (4,200 feet), ranging thence up to or above the Upper Santa Clara crossing. It was collected on the east slope of the Beaverdam Mountains, where it runs up to 1,090 meters (3,600 feet). A large species, probably the same, was found on the west slope of the Beaverdam Mountains, from 730 up to 1,340 meters (2,400 to 4,400 feet).

NOTE.—*Lyciums* were found in a number of localities not mentioned under the four species above enumerated for the reason that doubt attaches to the identification of the species. In many places two kinds were found growing together. One or more species were found in the following localities:

Leach Point Valley, and Perognathus Flat (in the Panamint Mountains), California; Pahrump Valley, Indian Spring Valley, and Highland Range, Nevada; Beaverdam Mountains and Lower Santa Clara Valley, Utah.

Chilopsis linearis.

Mr. Bailey and I did not find the desert willow in California or western Nevada, but encountered it for the first time at Upper Cottonwood Springs, at the east foot of the Charleston Mountains, Nevada, where it was common. It was common also at Bitter Springs in the Muddy Mountains, Nevada; at the point where Beaverdam Creek joins the Virgin in northwestern Arizona; on the east slope of the Beaverdam Mountains in Utah, where it reaches an altitude of 1,280 meters (4,200 feet), and in the Lower Santa Clara Valley.

Mr. F. V. Coville informs me that he found it in California, on the Mohave River, near Daggett.

Salvia carnosa.

This species was noted in the following localities in California:

Walker Pass.—Common up to 1,430 meters (4,700 feet) on the east side of the pass.

Kern Valley.—Common down to 820 meters (2,700 feet), or lower on northerly exposures.

Antelope Valley.—Abundant in places in a wash leading south from near Gorman Station toward Peru Creek; still lower down it is mixed with *Audibertia alba.*

Salvia pilosa [=*Audibertia pilosa*].

This small-leaved species (until recently known as *Audibertia incana pilosa*) was found at the following localities:

NEVADA.

Charleston Mountains.—Common in the neighborhood of Mountain Spring, from about 1,525 to 1,770 meters (5,000 to 5,800 feet).

Pahroc Mountains.—Found near Pahroc Spring.

Highland Range.—Common on the west slope.

Juniper Mountains.—Collected at an elevation of 1,680 meters (5,500 feet).

UTAH.

Beaverdam Mountains.—Abundant and in full flower May 10–11; ranges down to 1,100 meters (3,600 feet) on the east slope, and to 1,160 meters (3,800 feet) on the west slope.

NOTE.—A large-leaved species of *Audibertia* was found on several of the desert ranges. On the north slope of Gold Mountain a species was found as high as 2,100 meters (7,000 feet).

Salazaria mexicana.

This small shrub, which presents a very odd appearance when covered with its large inflated gibbous pods, is common in many parts of the desert region. It was noted in the following localities:

CALIFORNIA.

Mohave Desert.—Common in many places, reaching westward to Antelope Valley, and entering the mouth of Walker Pass, and also of the pass leading from Mohave to Tehachapi, where it attains an altitude of 1,035 meters (3,400 feet).

NEVADA.

Gold Mountain.—Found on the south slope of Gold Mountain, beginning at an altitude of 1,550 meters (5,100 feet) and ranging upward.

Oasis Valley.—A little is found in Oasis Valley above 1,220 meters (4,000 feet).

Indian Spring Valley.—Common throughout the valley. (Covered with inflated gibbous fruit globes May 29).

Pahranagat Valley.—Not found in the valley proper, but tolerably common on the divide south of Pahranagat Lake (altitude 1,150 meters, or 3,800 feet), and on the west side of the valley at the east foot of the Pahranagat Mountains above an altitude of 1,340 meters (4,400 feet).

Charleston Mountains.—Common on the west slope, ranging up from Pahrump Valley to 1,580 meters (5,200 feet), and on the east slope up to 1,525 meters (5,000 feet).

Muddy Mountains.—Common on east slope at an altitude of 600 to 760 meters (2,000 to 2,500 feet).

UTAH.

Santa Clara Valley.—Occurs sparingly in the valley, disappearing on the north side between 1,220 and 1,280 meters (4,000 and 4,200 feet).

Beaverdam Mountains.—Common on the lower slopes, ranging up to 1,100 meters (3,600 feet) on the east slope, and up to 1,340 meters (4,400 feet) on the west slope.

Atriplex confertifolia.

Atriplex confertifolia is the most characteristic species of desert brush on the *clayey alkaline soils of the* Upper Sonoran zone, from the Snake

Plains of Idaho southward, and reaches downward into the Lower Sonoran also.

CALIFORNIA.

Mohave Desert.—Common in suitable parts of the desert, and found as far west as a point a little north of Willow Spring, in Antelope Valley.

Owens Valley.—The commonest plant throughout a large part of Owens Valley, predominating over all other species; particularly abundant on suitable soil from Big Pine southward to a point 9 miles south of Owens Lake. On the east side of the valley it reaches up on the White and Inyo mountains to about 1,980 meters (6,500 feet) in the latitude of Big Pine.

NEVADA.

Fish Lake Valley.—Very abundant, and ranging thence up on the northwest slope of Mount Magruder in the wash leading to Pigeon Spring as high as 1,950 meters (6,400 feet), where it grows in company with *Sarcobatus vermiculatus* and *Stanleya pinnata.*

Valley between Mount Magruder and Gold Mountain.—Common, and mixed with *Artemisia tridentata, Grayia spinosa, Tetradymia glabrata*, and other species.

Grapevine Cañon.—Abundant.

Sarcobatus Flat.—The southern half of Sarcobatus Flat is covered with this species, very pure and free from admixture with other plants. To the north it becomes invaded by *Atriplex parryi, A. canescens, Artemisia spinescens, Tetradymia glabrata, Grayia spinosa*, and several other shrubs.

Oasis Valley.—Common throughout the valley, but disappearing abruptly at the south end, and not seen on the Amargosa Desert.

Ash Meadows.—The commonest plant on the dry, alkali soil, stopping with the alkali flat at the south end of the Amargosa Desert proper.

Indian Spring Valley.—Common about the large dry lake at the junction of the north arm with the main valley.

Emigrant Valley.—One of the commonest plants in the bottom at an altitude of a little more than 1,525 meters (5,000 feet) and extending thence easterly up the west slope of the Desert Range to 1,675 meters (5,500 feet) or higher.

Timpahute Desert.—One of the principal plants.

Pahranagat Valley.—Abundant in large patches on the bottoms and lower gravel slopes, and in the lower part of the wash coming into Pahranagat Valley from Pahroc Plain; ranges up on the west side of the valley to 1,430 meters (4,700 feet).

Desert Valley.—Common in the flat bordering the dry lake.

Meadow Creek Valley.—Abundant in the flat along the creek.

Pahrump Valley.—Very abundant on the flats in the bottom of the valley.

Virgin and Lower Muddy Valleys.—Common on the dry bottoms.

UTAH.

Santa Clara Valley.—Common in places in the lower valley.

Atriplex parryi.

This species apparently has the most restricted range of any of the shrubby forms of the genus. In California it was found in parts of Owens Valley between Big Pine and Lone Pine, and also along the west side of Owens Lake. In Ash Meadows, on the boundary between California and Nevada, it is one of the commonest bushes, covering the alkali flats and reaching north to the gravel *Larrea* plain that marks the beginning of the Amargosa Desert proper, where it ends abruptly because the soil is unsuitable. It reappears in Oasis Valley (beginning in the cañon at the foot of the valley at an altitude of 1,140 meters or 3,750 feet) where it extends all the way along the bottom, associated with *Atriplex confertifolia*, *A. canescens*, and *Sarcobatus vermiculatus*. A little was found at the bottom of Grapevine Cañon about a mile and a half from its east mouth, whence it extends easterly over the north part of Sarcobatus Flat, where, however, it is not abundant.

Atriplex hymenelytra.

This striking species, which grows on salty and alkaline soil in the Lower Sonoran zone, is not widely distributed over the deserts of southern California and Nevada. It is common in Death Valley, Panamint Valley, and Ash Meadows, and also in places in the Muddy and Virgin valleys in eastern Nevada, but was not found in Oasis Valley or in any of the other valleys of southern Nevada.

Atriplex polycarpa.

Of all the greasewoods, *Atriplex polycarpa* is the most distinctive of the lower division of the Lower Sonoran Zone, occupying the bottoms of the lowest deserts, and never occurring above, if as high as, the upper edge of the *Larrea*.

CALIFORNIA.

Mohave Desert.—Common in suitable bottoms; the principal brush on the clay flat a few miles west of Willow Spring, in Antelope Valley.

Owens Valley.—One of the commonest shrubs in the lower part of the valley from Lone Pine south to Haway Meadows (about 16 kilometers, or 10 miles, south of Owens Lake).

NEVADA.

Grapevine Cañon.—Grows in the bottom of the cañon about a mile and a half from Sarcobatus Flat.

Oasis Valley.—Common in the lower part of the valley.

Pahranagat Valley.—Not found in Pahranagat Valley proper, but common on the flat south of Pahranagat Lake at an altitude of about 1,070 meters (3,500 feet).

Virgin and Lower Muddy valleys.—Common on dry bottoms.

Pahrump Valley.—Common on the east side of the valley in the *Larrea* belt.

Atriplex canescens.

Atriplex canescens is one of the commonest and most generally distributed greasewoods of the Lower Sonoran Zone. It is abundant from the western arm of the Mohave Desert (Antelope Valley) in California to the foot of the Hurricane Cliffs in western Utah and Arizona. The following notes on its distribution were recorded.

CALIFORNIA.

Mohave Desert.—Abundant over most parts of the desert where the soil is alkaline and clayey. It reaches the extreme western end of Antelope Valley near Gorman Station, and occurs in the wash leading thence southerly toward Peru Creek, at an altitude of about 760 meters (2,500 feet).

Tehachapi Valley.—Tolerably common, coming in from the Mohave Desert through the open cañon at Cameron; seen also in Tehachapi Pass.

Walker Pass.—Runs up the east side of Walker Pass from the Mohave Desert to an altitude of about 1,425 meters (4,700 feet).

Owens Valley.—Common along the bottom and east side of Owens Valley up to about 1,980 meters (6,500 feet) along the west foot of the White and Inyo mountains; abundant in the narrow valley for about 9 miles south of Owens Lake.

Deep Spring Valley.—Grows in the bottom of the valley with *Grayia spinosa*, *Tetradymia spinosa*, *Menodora spinosa*, *Dalea polyadenia*, *D. fremonti*, *Lycium andersoni*, *Eurotia lanata*, and *Artemisia spinescens*.

NEVADA.

Fish Lake Valley.—Common in the bottom of Fish Lake Valley on the boundary between California and Nevada, and ranges thence up on the northwest slope of Mount Magruder nearly to Pigeon Spring, reaching an altitude of 1,980 or 2,010 meters (6,500 or 6,600 feet).

Sarcobatus Flat.—Common in the northern part of the flat.

Grapevine Cañon.—Found in the bottom of this broad and open cañon about a mile or a mile and a half west of Sarcobatus Flat.

Oasis Valley.—Common, beginning in the cañon at the foot of the valley at an altitude of about 1,150 meters (3,750 feet), and growing in company with *Atriplex confertifolia*, *A. parryi*, and *Sarcobatus vermiculatus*.

Indian Spring Valley.—Common about the dry lake a little north of the point where the north arm of Indian Spring Valley joins the main valley.

Emigrant Valley.—Common, and ranges thence easterly to the summit of the Desert Mountains near Mud Spring.

Timpahute Valley.—One of the principal plants; ranges easterly up the west slope of the Pahranagat Mountains to the divide.

Pahranagat Valley.—Abundant on most of the dry parts of the bottom and on gravel slopes, and ranging up a little above 1,500 meters (5,000 feet) on the west or Pahranagat Mountain side (much of it in flower May 22–26).

Desert Valley.—Common in places with *Artemisia spinescens* and *Eurotia lanata.*

Pahroc Plain.—Common, mixed with *Grayia*, *Eurotia*, and *Lycium andersoni*, and ranging as high as 1,980 meters (6,500 feet) on the Pahroc Mountains.

Meadow Creek Valley.—Common, and ranging up to 1,980 meters (6,500 feet) on west slope of Juniper Plateau.

Virgin and Lower Muddy valleys.—Common in the dryer parts of the valleys.

Pahrump Valley.—The most abundant brush on the alkaline bottoms, whence it ranges up the west slope of the Charleston Mountains to about 1,700 meters (5,600 feet).

UTAH.

Santa Clara Valley.—Common in places in the lower part of the valley.

Atriplex lentiformis.

This large species is not so generally distributed as most of the other members of the genus, and in places it may have been confounded with *A. torreyi*, from which it is not always easily distinguishable.

CALIFORNIA.

Mohave Desert.—Found growing north of Willow Spring, in Antelope Valley.

Amargosa Cañon.—Rather common with *A. torreyi.*

NEVADA.

Oasis Valley.—A few clumps seen.

Pahranagat Valley.—Common in patches on suitable soil, usually sand or fine gravel; generally rank and large.

Virgin and Lower Muddy valleys.—Common in dry parts of the valleys; sometimes in company with *A. torreyi.*

Great Bend of the Colorado River.—Occurs on the sand banks on the south side of Vegas Wash.

UTAH.

Santa Clara Valley.—Grows in the lower part of the valley.

Atriplex torreyi.

Atriplex torreyi is the largest species of the genus and grows in isolated localities throughout the Lower Sonoran zone. Small bushes are sometimes difficult to distinguish from *A. lentiformis.*

CALIFORNIA.

Owens Valley.—A little was seen on the west side of Owens Lake, and a few patches in the narrow valley between Owens Lake and Haway Meadows.

Amargosa Cañon.—Abundant, forming dense thickets.

NEVADA.

Valley of the Virgin and Lower Muddy.—Common in places in the dryer parts of the valley. Near an abandoned mill at St. Joe, on the Muddy, it forms dense and impenetrable thickets and grows to immense size, single bushes attaining a height of 4½ to 5½ meters (15 to 18 feet), with trunks 150 millimeters (about 6 inches) in diameter.

Pahranagat Valley.—A few scattering patches of rather small size were found.

UTAH.

Santa Clara Valley.—Grows in the lower valley.

Grayia spinosa [=*Grayia polygaloides*].

Grayia spinosa is one of the most characteristic bushes of the upper division of the Lower Sonoran Zone in the deserts of the southern part of the Great Basin. Owing to the peculiar green of its leaves and their tendency to assume a pinkish tint, it is easily distinguishable from the other brush with which it is associated. It was recorded from the following localities:

CALIFORNIA.

Mohave Desert.—*Grayia* is common in many of the higher levels of the Mohave Desert. It was found as far west as Antelope Valley a short distance east of Willow Spring, and a little was seen in the open cañon leading from Mohave to Tehachapi.

Walker Pass.—In Walker Pass it extends up the east slope from the Mohave Desert to an altitude of 1,330 meters (4,400 feet) or higher.

Owens Valley.—Common and ranges up on the west side (Sierra Nevada slope) to 1,525 or 1,550 meters (5,000 or 5,100 feet). On the opposite or White Mountain slope it ranges up to 1,980 meters (6,500 feet).

Deep Spring Valley.—Found in the bottom of the valley with *Tetradymia spinosa*, *Menodora spinosa*, *Atriplex canescens*, *Dalea polyadenia*, *D. fremonti*, *Artemisia spinescens*, *Lycium andersoni*, and *Eurotia lanata*.

NEVADA.

Fish Lake Valley.—Abundant, ranging up nearly to Pigeon Spring on the northwest slope of Mount Magruder, at an altitude of 1,980 to 2,040 meters (6,500 to 6,700 feet).

Valley between Gold Mountain and Mount Magruder.—Common, mixed with *Artemisia tridentata*, *Tetradymia glabrata*, *Atriplex confertifolia*, and a little *Artemisia spinescens*.

Gold Mountain.—Common below 2,135 meters (7,000 feet) altitude on the north slope, and down to 1,675 meters (5,500 feet) on the south slope.

Sarcobatus Flat.—Tolerably common in places in the northern part of the flat.

Oasis Valley.—Not common. Found from 1,220 meters (4,000 feet) upwards.

Timpahute Valley.—Scarce.

Pahranagat Valley.—Abundant on the gravel slopes and on dry gravel soil in the bottom of the valley and thence up to 1,645 meters (5,400 feet) on the west side (east slope Pahranagat Mountains). In fruit May 22–26.

Pahroc Plain.—Abundant on the gravel slopes, where it is the prevailing bush all the way from Pahroc Spring to Pahranagat Valley.

Desert Valley.—Abundant, in places forming large patches by itself unmixed with other species, and continuous with that of Pahroc Plain.

Meadow Creek Valley.—Common, mixed with the sage brush, and ranging up to 1,920 meters (6,300 feet) on the west slope of the Juniper Plateau, but this is above its usual limit.

Charleston Mountains.—Found on the east slope below 1,200 meters (4,000 feet).

UTAH.

Beaverdam Mountains.—Found on the east slope of the mountains from 1,095 meters (3,600 feet) down into the valley.

Santa Clara Valley.—Occurs in the lower valley, but disappears at about 1,220 to 1,280 meters (4,000 to 4,200 feet) on the north side of the valley (south exposure).

Eurotia lanata.

This well-known species, which is a valuable food plant for sheep, and is also eaten by horses, is common throughout the sage plains of Idaho and Nevada, and was found on many of the higher levels of the deserts traversed by the expedition. In the north it is commonly known as 'white sage,' but is a widely different plant from the so-called 'white sage' of the coastal slope and coast ranges of southern California, the latter being *Audibertia alba.*

CALIFORNIA.

Mohave Desert.—Common on the upper levels and extending up to 1,035 meters (3,400 feet), in the open cañon leading from Mohave to Tehachapi Valley.

Owens Valley.—Common among the sagebrush, and ranging up to a little above 1,550 meters (5,100 feet) on the Sierra slope.

Deep Spring Valley.—Tolerably common, with *Grayia spinosa*, *Menodora spinosa*, *Tetradymia spinosa*, *Dalea fremonti*, *D. polyadenia*, *Artemisia spinescens*, *Lycium andersoni*, and *Atriplex canescens* (altitude about 1,680 meters or 5,500 feet).

NEVADA.

Fish Lake Valley.—Abundant on the east side of the valley, ranging up to Pigeon Spring on the northwest slope of Mount Magruder (altitude 2,040 meters or 6,700 feet).

Sarcobatus Flat.—Tolerably common in places in the northern part of the flat.

Oasis Valley.—Common on the gravel slopes at the head of the valley at an altitude of about 1,340 meters (4,400 feet).

Emigrant Valley.—One of the commonest plants in the bottom of the valley at an altitude of 1,525 meters (a little above 5,000 feet).

Timpahute Valley.—One of the principal plants.

Pahroc Plain.—Common, mixed with *Grayia spinosa*, *Lycium andersoni*, and *Atriplex canescens*.

Desert Valley.—This valley is a remarkably typical *Eurotia* plain, thousands of acres between Pahroc Mountains and the Highland Range showing no other plant.

Meadow Creek Valley.—Extensive tracts (comprising many acres) are covered with this species alone.

Juniper Mountains (between Panaca, Nevada, and Shoal Creek, Utah).—Common in places among the sage and juniper.

UTAH.

Santa Clara Valley.—Rather common in places.

Allenrolfea occidentalis [= *Spyrostachys occidentalis*].

This small, scrubby plant (commonly known as *Spyrostachys occidentalis*) can endure more alkali and salt in the soil than any other species, and consequently is abundant on many of the salt flats where no other species grows. In Death Valley it forms a distinct border around the salt flat; and it occurs in similar soils easterly as far as the valley of the Virgin and Lower Muddy.

Suæda suffrutescens.

Suæda suffrutescens is a saline plant, requiring both salt and alkali in the soil in which it thrives. It can not stand so much salt as *Allenrolfea*, and consequently is found outside of the *Allenrolfea* belt around the true salt flats. It was recorded from the following localities:

NEVADA.

Grapevine Cañon.—Common in places.

Sarcobatus Flat.—Common in places in the northern part of the flat.

Oasis Valley.—Common throughout the bottom of the valley.

Pahranagat Valley.—Common in the lower part of the valley.

Valley of the Virgin and Lower Muddy.—Abundant on the salt flats.

Indian Spring Valley.—Common about the dry lake at the base of the north arm of Indian Spring Valley.

Sarcobatus baileyi.*

This new species of *Sarcobatus*, the second known in the genus, was first discovered by Mr. Vernon Bailey in the Candelaria salt marshes near Columbus, Nev., in winter. It was afterward found by Mr. Bailey and myself in Sarcobatus Flat, on the west side of the Ralston Desert, where it was common and in full fruit June 2, and on the east side of Fish Lake Valley, where it forms a narrow zone at an altitude

*Coville, Proc. Biol. Soc. Wash., vol. VII, May 18, 1892, pp. 77–78.

of about 2,010 meters (6,600 feet). It grows on gravel soil, while *S. vermiculatus*, as well known, grows on alkaline clayey soils.

Sarcobatus vermiculatus.

This characteristic desert shrub grows on clayey alkaline soils throughout the Upper Sonoran Zone, descending in places into the Lower Sonoran. It was observed in the following localities:

CALIFORNIA.

Owens Valley.—Common on the alkaline flats in the narrow valley between Owens Lake and Haway Meadows, and in places on the west side of the valley between Owens Lake and Lone Pine.

NEVADA.

Fish Lake Valley.—The most conspicuous plant on the mud flat in the bottom of the valley, whence it extends easterly on suitable soils to an altitude of 2,040 meters (6,700 feet) in the wash leading up to Pigeon Spring on the northwest slope of Mount Magruder.

Sarcobatus Flat.—Abundant on the clayey soil, growing on clay dunes as high as a man's head or higher. These *Sarcobatus* dunes were not found elsewhere and were such a peculiar feature of this desert that the name Sarcobatus Flat was given it on this account.

Oasis Valley.—Common throughout the bottom of the valley along with *Atriplex confertifolia* and *A. parryi.*

Pahranagat Valley.—Abounds throughout the clayey mud flats of the valley up to an altitude of about 1,280 meters (4,200 feet), and is distinguishable at a distance from the other shrubs by its peculiar green color.

Meadow Creek Valley.—Common along the bottom.

Desert Valley.—Common in large patches on the flat bordering the dry lake.

UTAH.

Shoal Creek.—Occurs in places on the mud flats bordering the creek.

Eriogonum polifolium.

This woody *Eriogonum*, the lower part of which is a true bush, is common on the upper levels of many of the deserts and along the bases of many of the desert ranges, where it was recorded from the following localities:

CALIFORNIA.

Mohave Desert.—Common on the higher levels.

Antelope Valley.—Common at the extreme west end of Antelope Valley in a wash leading south toward Peru Creek.

Tehachapi Basin.—Occurs, coming up from the Mohave Desert.

Walker Pass.—In Walker Pass it was common up to 1,430 meters (4,700 feet) on the east side; on the west or Kern River side it was found as low as 820 meters (2,700 feet) on northerly exposures.

Owens Valley.—West of Lone Pine this species is common and range up on the east slope of the Sierra to about 1,890 meters (6,200 feet).

Eriogonum inflatum.

This singular species, which was discovered by Fremont in his notable journey across the Mohave Desert in 1844, is common on most of the deserts in the southern part of the Great Basin, from California to Utah, usually occurring on gravelly soil. It is of slight value as a food plant for stock, being devoured by some mules and horses. On the east slope of Walker Pass it ranges up from the Mohave Desert to an altitude of 1,430 meters (4,700 feet).

Chorizanthe rigida.

This singular little plant flourishes on the hottest gravel beds of the hottest deserts of California, Nevada, Arizona, and southwestern Utah where it flowers in the early spring. It is the only species besides the creosote bush (*Larrea tridentata*) that grows on many of the black pebble beds which become so hot in the sun that all ordinary plants would be baked in a few moments. It was recorded in the following localities:

CALIFORNIA.

Panamint Valley.—Common in places.

Death Valley.—Common on the gravel slopes.

NEVADA.

Amargosa Desert.—Common, and over large areas the only plant growing with the *Larrea* on the hot pebble beds.

Grapevine Cañon.—Common, coming up from the northwest arm of Death Valley and ranging upward on the southwest slope of Mount Magruder as high as 1,830 meters (6,000 feet).

Oasis Valley.—Rather common.

Indian Spring Valley.—Common on the black pebble beds.

UTAH.

Santa Clara Valley.—Common on the warm gravel slopes.

Platanus occidentalis.

The sycamore was not found by us in the Great Basin, but is common in southern California. It grows in considerable abundance in the valley and gorge that the road follows in leading up from Caliente toward Walker Basin (on the west slope of the divide), where it ranges up from the valley to an altitude of 820 meters (2,700 feet). It was common also in the upper part of Cajon Pass in the San Bernardino Mountains, where it was coming into leaf March 30.

Betula occidentalis.

The western birch is common along some of the mountain streams on the west side of Owens Valley at the foot of the Sierra.

Alnus rhombifolia.

This alder, which grows to be a large tree, 9 meters (30 feet) or more in height, with a tall compact trunk, is common in the valley of the Kern River, on the west side of the Sierra in California.

Quercus undulata.

This evergreen scrub oak was found in the following localities:

NEVADA.

Charleston Mountains.—Common in scattered patches near Mountain Spring, and down on the west slope to 1,520 meters (5,000 feet).

Juniper Mountains.—Common in places in the juniper between Panaca, Nevada, and Shoal Creek, Utah.

UTAH.

Upper Santa Clara Valley.—Found in patches in the Upper Santa Clara Valley, beginning about 13 kilometers (8 miles) northwest of St. George, at an altitude of about 1,275 meters (4,200 feet) and ranging northward through Diamond Valley to the Upper Santa Clara Crossing and Mountain Meadows.

Beaverdam Mountains.—Occurs in places on the east slope between 1,100 and 1,300 meters (3,600 to 4,600 feet).

Quercus gambelii.

The Desert Range scrub oak was found in the following localities:

NEVADA.

Juniper Mountains.—Found sparingly from Shoal Creek, Utah, across the Juniper Mountain Plateau in eastern Nevada.

UTAH.

Mountain Meadows.—Common in scattered patches from the Upper Santa Clara Crossing northward to and beyond Mountain Meadows.

Quercus lobata.

The white oak is common in the Cañada de las Uvas, California, particularly on the grounds immediately about Old Fort Tejon, where it grows to a great and unusual size. Many trees near the old fort measure 6 meters (20 feet) or more in circumference a meter or more (3 or 4 feet) above the ground, and one measures 8 meters (26 feet 4 inches). A colony of purple martens (*Progne subis hesperia*) was found breeding in holes high up in these oaks at the time of our visit, the last week in June, 1891. *Quercus lobata* is common also about the borders of Tehachapi Valley. One we measured near summit, in the west end of the valley, was about 2 meters (6 feet) in diameter 2 meters (6 feet) above ground (circumference 5.8 meters or 19 feet 1 inch).

Quercus douglasii.

The blue oak is common in Kern Valley and thence southerly along the west slope of the Sierra Nevada to Walker Basin and Caliente. Between the two last-mentioned localities it forms open groves on the grassy hilltops, particularly along the main divide. It is common also at Liebre ranch, on the south side of Antelope Valley, which it reaches from the adjoining Sierra Liebre.

Quercus wislizeni.

This live oak is common along the western foothills of the Sierra Nevada, in California, and thence southward.

Quercus kelloggii.

Common on the west slope of the Sierra Nevada, where Mr. Bailey found it occupying a zone between the altitudes of 1,470 and 2,160 meters (4,900—7,200 feet) along the East Fork of Kaweah River.

Quercus dumosa.

Quercus dumosa is the scrub oak of the Sierra Liebre and Coast Ranges generally. It is common on the side hills about Antelope Valley, at the extreme west end of the Mohave desert, and thence down through the Cañada de las Uvas. It is common also in Cajon Pass.

Castanopsis chrysophylla.

The California chinquapin grows abundantly on the east slope of the High Sierra, in a narrow zone between 2,750 and 2,895 meters (9,000 and 9,500 feet) altitude, opposite Lone Pine.

Salix longifolia.

This small and slender willow forms open thickets about water courses and warm springs in some of the Lower Sonoran deserts. It was found in the following localities:

CALIFORNIA.

Death Valley.—Common along Furnace Creek, on the east side of Death Valley, mixed with *Pluchea sericea.*

Amargosa Cañon.—Found sparingly along the creek in the upper part of the cañon.

NEVADA.

Great Bend of the Colorado.—A slender willow forms extensive thickets along the river on both sides of the Great Bend.

Ash Meadows.—Abundant about the hot springs.

ARIZONA.

Beaverdam Creek.—Small willows are abundant on the flats bordering Beaverdam Creek, near its junction with the Virgin, in northwestern Arizona.

UTAH.

Santa Clara Valley.—Common along the Virgin, near the mouth of the Santa Clara.

Salix lævigata.

A single tree of this species marks the position of Lone Willow Spring, at the east foot of the Slate Range, near the extreme south end of Panamint Valley, California.

Salix nigra.

This large and handsome willow tree is common about the large springs at the two ranches in Pahrump Valley, Nevada.

Other tree willows (species not determined) were found about the ranches in Pahranagat Valley, Nevada; along streams on the west side of Owens Valley, California, in Kern River Valley, and in the lower part of the Cañada de las Uvas, below Old Fort Tejon.

Populus fremontii.

Cottonwood trees grow along some of the permanent water courses of the desert region and are often planted along irrigation ditches in the settlements. They were found at the following localities:

CALIFORNIA.

Kern Valley.—Common along the river.

Mohave Desert.—Common along the Mohave River near Victor, and in a few other places.

NEVADA.

Pahranagat Valley.—Common.

Pahrump Valley.—Common about the large springs.

Vegas Valley.—Common at Vegas Spring and ranch.

Valley of the Virgin and Muddy.—Very abundant along the streams in the Mormon settlements of St. Thomas, Bunkerville, and St. Joe.

ARIZONA.

Beaverdam Creek.—Abundant, forming a large forest on the flats bordering Beaverdam Creek, near its junction with the Virgin.

UTAH.

Santa Clara Valley.—Common along the Santa Clara and Virgin rivers.

Ephedra nevadensis.

This Lower Sonoran species differs conspicuously from the green species of the mountains (*Ephedra viridis*) by its olive color. It is common in many of the desert valleys and was noted in the following localities:

CALIFORNIA.

Mohave Desert.—Common, reaching west as far as Willow Spring, in Antelope Valley.

Tehachapi Valley.—Tolerably common, coming up from the Mohave Desert through the open cañon leading up from near Mohave. Found also in Tehachapi Pass.

Walker Pass.—On the east slope of Walker Pass the olive *Ephedra* runs up to 1,430 meters (4,700 feet), where it disappears and the green species (*E. viridis*) begins.

Kern Valley.—Observed at about 820 meters (2,700 feet).

NEVADA.

Pahrump Valley.—Common, reaching its upper limit on the east side (west slope of Charleston Mountains) at 1,370 meters (4,500 feet).

Pahranagat Valley.—Common everywhere on the gravel slopes.

Indian Spring Valley.—Common in the north arm.

Sarcobatus Flat.—Tolerably common in places.

Grapevine Cañon.—Found in the bottom of the cañon.

Emigrant Valley.—Common and ranging well up on the west slope of the Desert Mountains.

UTAH.

Beaverdam Mountains.—Found on the west slope of the Beaverdam Mountains up to 1,340 meters (4,400 feet), and on the east slope up to 1,100 meters (3,600 feet).

Santa Clara Valley.—Occurs sparingly in the lower part of the valley.

Ephreda viridis Coville.

This green *Ephedra* does not occur in any of the Lower Sonoran deserts, but grows on the mountain sides and plateaus of the Upper Sonoran and Transition zones with sagebrush (*Artemisia tridentata*) and juniper (*Juniperus californica utahensis*). The following notes on its distribution were recorded:

CALIFORNIA.

Mohave Desert.—Tolerably common at the summit of Cajon Pass and thence along the north base of the San Bernardino Mountains, in the juniper belt.

Walker Pass.—On the east slope of Walker Pass this species begins at 1,430 meters (4,700 feet) with *Artemisia tridentata* and ranges up; on the west slope it is common between 1,250 and 1,400 meters (4,100 and 4,600 feet).

Sierra Nevada.—Common on the east (Owens Valley) slope from 2,750 meters (9,000 feet) or higher, down to 1,830 meters (6,000 feet); and still lower in places on the Alabama Range.

White Mountains.—Rather common along the summit.

Panamint Mountains.—Common on the higher parts of the range. In the basin above Wild Rose Spring it begins above *Coleogyne* at 2,740–2,980 meters (6,300–6,500 feet) and runs up to the summit at the west base of Telescope Peak, altitude 2,560 meters (8,400 feet).

NEVADA.

Mount Magruder.—Common over the higher parts of the mountain, ranging all the way up to the summit of the main peak with *Artemisia tridentata;* occurs also in the upper part of Tule Cañon.

Gold Mountain.—Common on the summit and ranges down on the south slope to 1,830 meters (6,000 feet) with *Artemisia tridentata.*

Pahranagat Mountains.—Tolerably common.

Highland Range.—Occurs.

Charleston Mountains.—Common, ranging down on the west slope to 1,430 meters (4,700 feet).

UTAH.

Beaverdam Mountains.—Common, descending to 1,340 meters (4,400 feet) on the west slope, and to 1,100 meters (3,600 feet) on the east slope.

Pinus monophylla.

Pinus monophylla is the only pine belonging properly to the Great Basin region, where it occupies the summits of the desert ranges in company with *Juniperus californica utahensis.* It belongs to the Upper Sonoran and Transition zones, and consequently is absent from the highest peaks of the White and Charleston mountains, whose summits are truly Boreal. It usually begins a few hundred feet above the lower border of the juniper belt and ranges up a little higher than the juniper, though the two are mixed over the greater part of their ranges. In some areas the juniper predominates, as in the Juniper Plateau between Meadow Creek Valley, Nevada, and the Escalante Desert in Utah, while in other areas the nut pine predominates, as on Mount Magruder.

Pinus monophylla is easily distinguished from the piñon of Arizona (*Pinus edulis*) by its greater size, larger nuts, and single leaf. *P. edulis* has two leaves. Both species have short and open cones from which the nuts are easily dislodged by shaking. The nuts are eagerly devoured by wild turkeys, piñon jays, and many other species.

The nut pine furnishes the most important food of the Indians inhabiting the southern part of the Great Basin, namely, the Paiutes, Shoshones, and Panamints, who gather its cones in large quantities and roast them in heaps, after which the nuts are extracted and placed in large caches for winter use. They are eaten in a raw state as well as roasted, and are pounded into flour and baked into a sort of bread.

Mount Magruder is notable for the luxuriance of the nut pine forests which clothe its higher hills and peaks, and has long been a favorite resort of the Paiute Indians, who speak of it as 'Nut Pine Mountain,' and spend a considerable part of each year there for the sole purpose of collecting the nuts. The trees often attain a height of 12 or even 15 meters (40 to 50 feet) and a diameter of half a meter (nearly 20 inches). The following notes were recorded on the distribution of the nut pine in the region traversed:

CALIFORNIA.

Sierra Nevada.—On the east slope of the Sierra opposite Lone Pine the nut pine belt ranges from 1,830 to 2,440 meters (6,000 to 8,000 feet) in width.

Walker Pass.—On the east side of Walker Pass it begins a little above 1,430 meters (4,700 feet) on northerly exposures and ranges up over the summit of the pass at 1,525 meters (5,000 feet) and down on the west slope as low as 1,310 meters (4,300 feet) in places.

Tehachapi Mountains.—Common, and ranging down to about 1,130 meters (3,700 feet) on the side of the open cañon leading from Tehachapi Valley to the Mohave Desert.

Panamint Mountains.—Common with the juniper along the summit of the Panamint Range. In the basin above Wild Rose Spring on the northwest slope of Telescope Peak it descends to 1,980 or 1,920 meters (6,500 or 6,300 feet), and ranges up on this peak to 2,740 meters (9,000 feet), or higher. Heaps of cones were found in many places in the Panamint Mountains, where they had been left by the Indians after the nuts had been extracted.

White Mountains.—Common, descending to 2,040 meters (6,700 feet) on the east slope above Deep Spring Valley.

NEVADA.

Charleston Mountains.—Common with the juniper, descending on the west slope to about 1,550 meters (5,100 feet).

Pahroc Mountains.—Common on the higher parts of the range, and lower down in the cañons.

Gold Mountain.—Common along the summit, descending on the south side as low at least as 2,070 meters (6,800 feet).

Mount Magruder.—As already stated, the nut pine grows in greater abundance on Mount Magruder than in any other locality visited by the expedition, forming handsome forests on many of the knobs and peaks that rise from the mountain plateau, where it is very little mixed with juniper.

Juniper Mountains.—Scarce in the dense juniper forest extending from Meadow Creek Valley, Nevada, to the Escalante Desert in Utah.

UTAH.

Upper Santa Clara Valley.—Begins about 13 kilometers (8 miles) northwest of St. George on south exposures at an altitude of about 1,270 meters (4,200 feet) and grows scattering on the side hills in the Upper Santa Clara Valley, ranging thence westerly to the Shoal Creek country.

Beaverdam Mountains.—Tolerably common on the Beaverdam Mountains, ranging down on the east side to about 1,160 meters (3,800 feet), and on the west slope to about 1,340 meters (4,400 feet).

ARIZONA.

Virgin Mountains.—On the west side of the Virgin Mountains the nut pine forms a broad zone, mixed with juniper, coming fully halfway down to the foot of the range.

Pinus ponderosa.

Mr. Bailey tells me that *Pinus ponderosa* is common on the west slope of the Sierra Nevada along the East Fork of Kaweah River, growing with *Sequoia gigantea* in a belt between the altitude of 1,830 and 2,100 meters (6,000 to 7,000 feet). Its range is below that of *Pinus jeffreyi*.

Pinus ponderosa scopulorum.

The yellow pine grows in a broad zone on Charleston Peak, Nevada, and on Pine Valley Mountain, Utah, in both of which localities it is cut for lumber. It is said to be common in the higher parts of the Virgin and Highland ranges. A few scattering trees were found on the higher hills of the Juniper Mountains near Sheep Spring (between Panaca, Nevada, and Shoal Creek, Utah), at an altitude of about 2,040 meters (6,700 feet).

Pinus jeffreyi.

This large pine is common in the High Sierra in California, ranging upward on the east slope from about 2,750 meters (9,000 feet) to 2,900 meters (9,500 feet).

Pinus murrayana.

On the High Sierra in California *Pinus murrayana* reaches timber-line with *P. balfouriana*, and ranges down on the east side to an altitude of about 2,900 meters (9,500 feet) or lower, growing to be a large tree.

Pinus balfouriana.

In the High Sierra in California, *Pinus balfouriana* and *P. murrayana* reach timber-line, whence they descend on the east slope to an altitude of about 2,900 meters (9,500 feet) or a little lower, where they grow to be large trees 15 to 20 meters (50 to 65 feet) in height and a meter or more (3 or 4 feet) in diameter.

Pinus aristata.

P. aristata was found on the summit of the Panamint Mountains, in California, by Mr. Bailey and Dr. Fisher, and on Charleston Peak, Nevada, by Mr. Coville and Mr. Palmer.

A pine of this type was found by Mr. Nelson on the higher parts of the White and Inyo mountains, California, but whether *P. aristata* or *P. balfouriana* is not certain.

Pinus sabiniana.

This remarkable tree, with very open foliage and huge cones, is characteristic of the west slope of the Sierra and the Coast Ranges of California, and does not occur anywhere within the Great Basin. It was common along the route traversed from a mile west of the summit of Walker Pass to Kernville, and thence southward to Walker Basin, and was found also on the Sierra Liebre, growing with and below *Pinus monophylla*, and descending on the north slope nearly to Antelope Valley in the neighborhood of Liebre ranch.

Pinus monticola.

Pinus monticola is one of the timber-line trees. On the rocky west slope of the Sierra Nevada, above Mineral King, Mr. Bailey found it at an altitude of 2,930 meters (9,600 feet), and thence upward to 3,120 meters (10,400 feet). In that locality but one pine (*Pinus balfouriana*) extended higher.

Pinus lambertiana.

Common on the west slope of the Sierra Nevada in a well-marked belt, the vertical breadth of which along the East Fork of Kaweah River was determined by Mr. Bailey to be about 360 meters (1,200 feet), or from 1,830 to 2,160 meters (6,000 to 7,200 feet) in altitude. Mr. Bailey found it common at Trout Meadows, and thence along the upper Kern River to above Soda Springs.

Pinus flexilis.

In California this species was found on the Panamint Mountains above an altitude of about 3,050 meters (10,000 feet), and on the High Sierra, where it ranges from 2,830 to 3,050 meters (9,300 to 10,000 feet). In Nevada it was found on Charleston Peak by Mr. Coville and Mr. Palmer.

Abies magnifica.

Common on the High Sierra. Mr. Bailey informs me that he observed it on the west slope near Mineral King at an altitude of 2,230 meters (7,450 feet), and thence up to about 3,090 meters (10,300 feet), where it nearly reaches timber-line.

Abies concolor.

Common on the High Sierra. On the west slope Mr. Bailey found it between the altitudes of 1,830 and 2,160 meters (6,000 to 7,200 feet) on the East Fork of Kaweah River, and up to 2,300 meters (7,700 feet) on Kern River.

Pseudotsuga macrocarpa.

This species of spruce occurs in gulches on the west side of Cajon Pass at an altitude of 670 meters (2,200 feet) and upwards, and was found also on the south side of the Sierra Liebre along the upper valley of Peru Creek, just below Alamo ranch. Cajon Pass is the type locality of this species.

Sequoia gigantea.

Sequoia gigantea forms a conspicuous but narrow and interrupted belt on the west slope of the Sierra Nevada. Mr. Bailey informs me that along the East Fork of Kaweah River he found it between the altitudes of 1,830 to 2,000 meters (6,000 to 6,600 feet), on a very gradual slope, so that the actual breadth of the forest was about 5 miles.

Libocedrus decurrens.

Mr. Bailey found *Libocedrus decurrens* common on the west slope of the Sierra Nevada, along the East Fork of Kaweah River, from 1,830 to 2,160 meters (6,000 to 7,200 feet) altitude, and along the North Fork of Kern River up to the cliffs above Soda Springs.

Juniperus californica.

The typical form occurs on the coastal slope of the Great Divide in California, sometimes ranging over a short distance on the Great Basin side, as along the north base of the San Bernardino Mountains.

It was observed in the following localities:

CALIFORNIA.

West slope of the Sierra.—Common on the sidehills about Kernville, where it descends as low as 790 meters (2,600 feet) on the north slopes, and ranges southward along the road from Kernville to Havilah. It reaches the summit of Walker Pass (1,550 meters, or 5,100 feet).

Sierra Liebre.—Common on the north slope opposite the western part of Antelope Valley.

Tehachapi Mountains.—Common, ranging down into the tree yuccas on the side of the open cañon leading from Tehachapi Valley down to Mohave (altitude, about 1,090 meters, or 3,600 feet).

Mohave Desert and San Bernardino Mountains.—Along the north foot of San Bernardino Mountains, at the extreme southern edge of the Mohave Desert, is a well-defined belt of juniper about 8 miles in width, ranging from the summit of Cajon Pass at an altitude of 1,215 meters (4,000 feet) down through the upper part of the tree yucca zone to an altitude of 1,060 meters (3,500).

Juniperus californica utahensis.

Juniperus californicus utahensis, either alone or in company with the nut pine (*Pinus monophylla*), clothes the summits of most of the desert ranges, where it reaches as high as the upper limit of the Transition zone. It is the only juniper inhabiting the southern part of the Great Basin, and does not grow below the Upper Sonoran zone; consequently it is absent from the lower ranges and also from the excessively barren Funeral and Amargosa ranges between Death Valley and the Amargosa Desert. The following notes on its distribution were recorded:

CALIFORNIA.

White and Inyo mountains.—Abundant along the summit of the range (except on the higher peaks of the White Mountains, which are too high for it and are clothed with pines and spruces). On the east slope of the White Mountains, opposite Deep Spring Valley, junipers descend with nut pines to 2,040 meters (6,700 feet).

Panamint Mountains.—Common throughout the higher parts of the range. In the basin above Wild Rose Spring on the northwest slope of Telescope Peak, junipers begin at 1,900 meters (about 6,300 feet), and run up to 2,550 meters (8,400 feet) or higher.

NEVADA.

Mount Magruder.—The juniper is scarce on Mount Magruder, where its place is taken by the nut pine (*Pinus monophylla*).

Gold Mountain—Common in sheltered cañons, and in places on the summit.

Hungry Hill Summit.—Common on the divide and neighboring hills, reaching down on the south side to about 1,525 meters (5,000 feet).

Pahranagat Mountains.—Common on the summit of the range, reaching down to 1,585 meters (5,200 feet) on the east slope.

Pahroc Mountains.—Common on the higher parts of the range and in cañons.

Hyko Range.—Common on the higher parts.

Highland Range.—Abundant, descending to about 1,830 meters (6,000 feet) on the west side. On the east side of the Highland Range it descends to 1,700 meters (5,600 feet), thus reaching within a few hundred feet of the bottom of Meadow Creek Valley.

Juniper Mountains (between Meadow Creek Valley, Nevada, and Shoal Creek, Utah).—The most extensive and purest juniper forest I have ever seen covers the rolling plateau along the boundary between Nevada and Utah, reaching from an altitude of 1,765 meters (about 5,800 feet) on the east side of Meadow Creek Valley, Nevada, all the way across to Shoal Creek on the borders of the Escalante Desert in Utah. This continuous juniper forest is more than 20 miles in breadth without a break and is mixed with very little nut pine. On the Shoal Creek side it descends to 1,830 meters (6,000 feet). The altitude of the plateau which it occupies, and which is here called the Juniper Mountains for lack of a better name, varies from a little over 1,830 meters (6,000 feet) up to about 2,100 meters (7,000 feet).

Charleston Mountains.—Common throughout the Charleston Mountains, except on the summit of the main peak, which is too high for it. On the west slope (Pahrump Valley side) it descends to 1,550 meters (5,100 feet).

ARIZONA AND UTAH.

Virgin and Beaverdam mountains.—Common in a broad zone on the Virgin Mountains, reaching down more than halfway to the valley; and on the west slope of the Beaverdam Mountains down to 1,340 meters (4,400 feet).

UTAH.

Beaverdam Mountains.—On the east slope junipers descend to 1,095 meters (3,600 feet) spreading out to the northward over the upper part of the Upper Santa Clara Valley, where they cover all the sidehills.

Pine Valley Mountain.—Abundant in a broad zone around the base of the mountain, and stretching thence northwesterly over the Upper Santa Clara Valley, forming a sparse forest on the hillsides until it reaches the Shoal Creek country, where it joins the continuous forest already described. In the Upper Santa Clara Valley it descends to 1,280 meters (about 4,200 feet) at a distance of only 13 kilometers (8 miles) northwest of St. George, thence forming a scattered forest over the sidehills in a belt at least 10 miles wide south of the Upper Santa Clara crossing, and reaching thence northerly to the borders of the Escalante Desert, south of which it is continuous with the great forest covering the Juniper Plateau.

Juniperus occidentalis.

This species grows on the higher summits of the Panamint Mountains, California, above the upper limit of *Juniperus californica utahensis.* On the north slope of Telescope Peak Mr. Bailey found it as high as 2,830 meters (9,300 feet).

Juniperus occidentalis monosperma.

This subspecies was identified by Mr. Coville as the form growing high up in the Charleston Mountains, Nevada.

Tumion californicum.

This singular tree grows along the west slope of the Sierra Nevada. Mr. Bailey found it on the East Fork of Kaweah River between the altitudes of 1,170 and 1,830 meters (3,950 to 6,000 feet).

NOTES ON THE GEOGRAPHIC AND VERTICAL DISTRIBUTION OF CACTUSES, YUCCAS, AND AGAVE, IN THE DESERTS AND DESERT RANGES OF SOUTHERN CALIFORNIA, SOUTHERN NEVADA, NORTHWESTERN ARIZONA, AND SOUTHWESTERN UTAH.

By C. Hart Merriam, M. D.

The following notes on the vertical and geographic distribution of the desert cactuses, yuccas, and agave were made by me in April, May, and June, 1891, along the route traversed from the north end of Cajon Pass, in the San Bernardino Mountains, to the St. George Valley at the foot of the Hurricane Cliffs, in southwestern Utah, and thence westerly across Nevada to Owens Valley, California, and southward and southwestward to the extreme end of the western tongue of the Mohave Desert (Antelope Valley), including the several passes (Walker, Tehachapi, and the Cañada de las Uvas), by means of which communication is established between the Mohave Desert on the east and the Bakersfield Plain or upper San Joaquin Valley on the west. A detailed itinerary of this trip may be found in Part I of the present report.

Nearly all of the species were photographed by me in the field, and in most instances parts of the individual plant photographed were brought back for positive identification. As in the case of the desert shrubs, Mr. F. V. Coville is responsible for the nomenclature employed.

LIST OF CACTUSES, YUCCAS, AND AGAVE.

Cereus engelmanni.
mohavensis.
Opuntia acanthocarpa.
bernardina.
echinocarpa.
whipplei.
parryi.
ramosissima.
pulchella.
basilaris.
engelmanni occidentalis.
rutila.
Echinocactus johnsoni.
polycephalus.
polyancistrus.
wislizeni lecontei.
Mamillaria sp.
Yucca baccata.
arborescens.
elata?
macrocarpa.
whipplei.
Agave utahensis.

Cereus engelmanni.

This is the commonest and most widely diffused cactus of the genus *Cereus* over the deserts of southern Nevada and southeastern California, where it was found in the following localities:

CALIFORNIA.

Deep Spring Valley.—Tolerably common in the wash leading up from Deep Spring Valley to the pass over the White Mountains; in full flower June 10. Found also on the Inyo Mountains.

Panamint Mountains.—Common in places.

NEVADA.

Gold Mountain.—Tolerably common on the south slope above 1,550 meters (5,100 feet); in flower June 3.

Timpahute and Desert Mountains.—Tolerably common on both slopes.

Pahranagat Valley.—Common on rocky slopes; in full flower May 22–26.

Pahranagat Mountains.—Common in places.

Juniper Mountains.—Common; in flower May 5.

Muddy Mountains.—Rather common; in full flower May 5.

UTAH.

Beaverdam Mountains.—Common, ranging from 730 to 1,350 meters (2,400 to 4,400 feet) on the west slope, and from 1,100 to 1,300 meters (3,600 to 4,300 feet) on the east slope; in flower May 10–11.

Santa Clara Valley.—Occurs in places; in flower May 11–15.

Cereus mohavensis.

This cactus grows in dense clumps in rocky places on the sides of the Desert Ranges, usually in cañons, and bears dark, purple-red flowers. It was observed in the following localities:

CALIFORNIA.

White Mountains.—Common in places on the east slope above Deep Spring Valley, beginning at an altitude of 1,900 meters (6,300 feet) and ranging up to the summit of the divide; in flower June 10.

Panamint Mountains.—Common in places along the summit, particularly north of Telescope Peak; not yet in flower, April 17–19.

NEVADA.

Charleston Mountains.—Found in a few places on the west slope of the Charleston Mountains above 1,550 meters (5,100 feet); beginning to flower April 29.

Pahranagat Mountains.—Found along the summit of the range; in flower May 26.

Highland Range.—Found on the west slope of the range; in flower May 20.

Juniper Mountains.—Tolerably common in places among the junipers from 1,820 to 2,050 meters (6,000 to 6,700 feet) in altitude; in flower May 18–19.

UTAH.

Santa Clara Valley.—Found in the Upper Santa Clara Valley at an altitude of 1,500 or 1,525 meters (4,900 or 5,000 feet). Its deep red flowers were fully open May 16.

Opuntia acanthocarpa. (Plates VII and VIII.)

This cylindrical-stemmed cactus, which is considerably larger than *O. echinocarpa*, from which it differs also in having more distant branches and fewer spines, was not observed in California or western Nevada, but was found in eastern Nevada, on the east side of the valley of the Virgin, a few miles from the Mormon town of Bunkerville, and thence easterly to an altitude of 1,340 meters (4,400 feet) on the west slope of the Beaverdam Mountains, in Utah. On the east slope of the Beaverdam Mountains it was found between 1,090 and 1,300 meters (3,600–4,300 feet). It was found also in the Lower Santa Clara Valley, Utah.

Opuntia bernardina.

This tall, arborescent, cylindrical cactus barely enters the region explored by the expedition. In southern California it is common on the San Bernardino Plain, and ranges northward through Cajon Pass, becoming scarce toward the summit. A little further west it is common in the Santa Clara Valley near the mouth of Castac Creek (about 4 miles north of the railroad switch 'Castac') at an altitude of 335 meters (1,100 feet) and thence southerly. In the region in which it grows it forms the favorite nesting sites for the cactus wren (*Campylorhynchus brunneicapillus*).

Opuntia echinocarpa.

This is the common arborescent cactus of the Mohave Desert region and the deserts of southern Nevada, over which it is widely distributed. It has inconspicuous green flowers, and was in blossom at the south end of Death Valley April 26, and at Bitter Springs, Nevada, May 5.

Two characteristic desert birds build their nests in this cactus almost exclusively, namely, Leconte's thrasher (*Harporhynchus lecontei*) and the cactus wren (*Campylorhynchus brunneicapillus*), and another species, the black-throated desert sparrow (*Amphispiza bilineata*), nests in it and in other situations also.

CALIFORNIA.

Mohave Desert.—Common and widely distributed, reaching westerly throughout Antelope Valley. It runs up the open cañon leading from Mohave to Tehachapi as high as 1,050 meters (3,450 feet).

Walker Pass.—Common among the tree yuccas on both sides of the pass, descending in Kern Valley as low as 820 meters (2,700 feet) or perhaps still lower.

Owens Valley.—Common, and ranging up on the west side (east slope of Sierra) to 1,830 or 1,900 meters (6,000 or 6,200 feet).

Panamint Valley.—Common.

Death Valley.—Common, beginning to flower at Saratoga Springs April 26 (flowers green).

Deep Spring Valley.—Occurs on the west side in the wash leading up to the pass over the White Mountains.

NEVADA.

Pahrump Valley.—Common, reaching up to the divide near Mountain Spring on the Charleston Mountains, at an altitude of 1,700 meters (5,600 feet).

Vegas Valley.—Common.

Bitter Springs.—Common in the Muddy Mountains and in flower May 5.

Valley of the Virgin and Lower Muddy.—Common on the gravel mesa between the Muddy and Virgin rivers.

Fish Lake Valley.—Occurs and ranges up on northwest slope of Mount Magruder to 1,950 meters (6,400 feet).

Grapevine Cañon.—Occurs.

Timpahute and Desert mountains.—Occurs.

Pahranagat Valley.—Common.

Pahranagat Mountains.—Occurs.

UTAH.

Beaverdam Mountains.—Comes up on the northwest slope of the Beaverdam Mountains to 1,150 meters (3,800 feet) from the Upper Virgin Valley.

Santa Clara Valley.—Common in the Lower Santa Clara Valley in the neighborhood of St. George, but not observed on the east slope of the Beaverdam Mountains. In the Upper Santa Clara Valley it is replaced by the larger and much handsomer densely-spined species *O. whipplei.*

Opuntia whipplei. (Plate IX.)

This remarkable species, noteworthy on account of the closeness of its branches, the shortness of its joints, and the multitude of its spines, is abundant in patches among the juniper and sagebrush along the Upper Santa Clara River, near the upper crossing in Utah, at an altitude of about 1,525 meters (5,000 feet), and was found also on the west slopes of the Highland and Juniper ranges in Nevada, but was not seen elsewhere. On the west slope of the Juniper Plateau it was found between the altitude of 1,830 and 1,980 meters (6,000 and 6,500 feet). The fruit differs from that of *O. echinocarpa* in bearing few or no spines.

Opuntia parryi. (Plate X.)

This species was found only in Indian Spring Valley, Nevada, and on the west slope of the Charleston Mountains, below Mountain Spring. In Indian Spring Valley it is confined to a limited area about 17 miles west of Indian Spring on and near the low divide between this valley and Ash Meadows. It is a remarkably prostrate form of the cylindrical-stemmed section of the genus, and its characters are well shown in the accompanying photograph.

Opuntia ramosissima.

This very characteristic species, easily recognized by the small diameter of its stems and branches, was not found in California or in Nevada west of the North Kingston Mountains, where it was first seen, and where it seems to reach its western limit. It was found also throughout Indian Spring Valley and on both slopes of the Timpahute and Desert mountains, ranging down on the east side (west side of Timpahute Desert) to 1,500 meters (4,900 feet), and was seen on the east side of the Valley of the Virgin, near Bunkerville, Nev., and near the mouth of Beaverdam Creek, Arizona.

Opuntia pulchella.

This singular little species, having a remarkably large root, was observed in but a single locality, namely, the south end of Fish Lake Valley, on the boundary between California and Nevada, where it was in full flower June 8. The blossoms are pink.

Opuntia basilaris.

Opuntia basilaris is one of the commonest cactuses of the Sonoran deserts, and may be recognized by the obcordate shape of its pads and the scantiness of its spines. Its purple-red flowers grow in great numbers on the upper edges of the pads, as many as eight open blossoms and several buds having been seen on a single pad at one time. The species was observed in the following localities:

CALIFORNIA.

Mohave Desert.—Common in places.

Tehachapi Valley and Pass.—Tolerably common, and still in flower as late as June 25.

Walker Pass and Kern Valley.—Common on the east slope up to 1,430 meters (4,700 feet). On the west slope it descends into the valley of Kern River, where it is tolerably common on northerly exposures as low as 820 meters (2,700 feet).

Owens Valley.—Tolerably common in places.

Deep Spring Valley.—Found in the wash leading up from Deep Spring Valley to the pass over the White Mountains.

Panamint Valley.—Common in places, running over the greater part of the Panamint Mountains, where it was tolerably common in Perognathus Flat.

Death Valley.—Common in places, particularly at Saratoga Springs at the south end of the valley, where it was in full flower as early as April 26.

NEVADA.

Fish Lake Valley.—Tolerably common, ranging up on the northwest slope of Mount Magruder to about 1,850 meters (6,100 feet).

Grapevine Cañon.—Common on the north side of the cañon and ranging up on the Gold Mountain slope between 1,525 and 1,830 meters (5,000 and 6,000 feet).

Timpahute Mountains.—Abundant and flowering profusely. Ranges up to 1,275 or 1,300 meters (4,200 or 4,300 feet) on the road to Pahroc Plain. Occurs also on Pahranagat Mountains.

Muddy Mountains.—Common near Bitter Spring (in full flower May 5).

Valley of the Virgin and Lower Muddy.—Common on dry gravel soils.

ARIZONA AND UTAH.

Beaverdam Mountains.—Common on the east side of the Virgin Valley, ranging thence up on the west slope of the Beaverdam Mountains to 1,150 meters (3,800 feet).

Opuntia engelmanni occidentalis.

Abundant throughout the San Bernardino Plain, ranging up to the base of the San Bernardino Mountains and entering the lower part of Cajon Pass, where it reaches an altitude of about 730 meters (2,400 feet). It occurs in patches in the Santa Clara Valley near the mouth of Castac Creek. In Castac Valley the highest plant was seen on the north side at an altitude of 600 meters (2,000 feet), but it was rare above 330 meters (1,100 feet), where both it and *Opuntia bernardina* became common together about 4 miles north of the railway switch known as 'Castac.'

A related cactus, which Mr. Coville informs me is probably *Opuntia chlorotica*, was found along the Colorado River, in the western part of Vegas Desert near Lower Cottonwood Springs, and on the west slope of the Charleston Mountains between 1,675 and 1,730 meters (5,500 and 5,700 feet) altitude.

Sheep Spring, Juniper Mountains.—A cactus resembling *Opuntia engelmanni*, but with smaller and more spiny pads, which differ further from those of *O. engelmanni* in not growing on top of one another several tiers high, was common in the sage and juniper in the Juniper Mountains between Meadow Creek Valley, Nevada, and Shoal Creek, Utah, from 1,920 to 2,070 meters (6,300 to 6,800 feet) altitude.

Opuntia rutila. (Plate XI.)

This species, which has enormously long and slender spines, was not found in California except on the Panamint Mountains, where it was common along the summit, ranging down on the west slope above Wild Rose Spring to an altitude of 1,900 meters (6,300 feet). In Nevada it was found on the Charleston, Pahranagat, Desert, and Timpahute mountains, and in the Virgin Valley. In Utah it was found on the west slope of the Beaverdam Mountains, up to 1,150 meters (3,800 feet), and occurred in places in the Santa Clara Valley.

Along the west base of the Desert Mountains near Quartz Spring it was common and in flower May 27, and the flowers were yellow. All of the other flowers seen were red. It is possible that two species are here confounded.

Echinocactus johnsoni.

This species is about one-third the size of *E. wislizeni*, which it greatly resembles. Its flowers are deep red. It was found on the west slope of the Beaverdam Mountains in southwestern Utah, at an altitude of 1,030 meters (3,400 feet), and ranged thence up over the divide to 1,525 meters (5,000 feet). A small form referred to the same species was common on steep gravel slopes in Vegas Wash, Nevada, where it was in full flower May 3. It was eaten by the Paiute Indians, who peel it as we would a cucumber.

Echinocactus polycephalus.

This striking species, commonly called 'nigger-head' in the desert region, and resembling loose clusters of cocoanuts, is common on many of the desert valleys in the southern part of the Great Basin. It was observed in the following localities:

CALIFORNIA.

Inyo Mountains.—Found along the west side of the range in Owens Valley.

Panamint Mountains.—Found in the upper part of the *Larrea* on the west side of the divide between Perognathus Flat and Wild Rose Spring.

NEVADA.

Indian Spring Valley.—Common on the rocky walls of the cañon leading from the extreme west end of Indian Spring Valley down toward Ash Meadows.

Desert Mountains.—Grows sparingly along the west base of the Desert Mountains, near Quartz Spring.

North Kingston Range.—Common in places.

Ash Meadows.—Common on the low rocky mountains on the east side of Ash Meadows.

Pahranagat Valley.—A few clusters of heads were seen in rocky places on the east side of the valley.

Muddy Mountains.—A few seen in the Muddy Mountains above Bitter Springs.

Valley of the Virgin and Lower Muddy.—Found in a few places among rocks, particularly on the gravel mesa near the boundary line between Arizona and Nevada. Common on the high mesa between the Virgin and Muddy.

[The species was not seen on the east slope of the Beaverdam Mountains, in Utah.]

Echinocactus polyancistrus.

This species, which resembles a pineapple in general size and appearance, was found in flower on the east slope of the White Mountains, California, a little above the south end of Fish Lake Valley, June 9. The flowers are red.

Echinocactus wislizeni lecontei.

This large barrel-cactus is not common in the region traversed. In California it was found in the Panamint Mountains (common in Surprise Cañon).

NEVADA.

Virgin Mesa.—Common on the high gravel mesa between the Virgin and Muddy valleys.

UTAH.

Beaverdam Mountains.—Found on the west slope of the Beaverdam Mountains between 730 and 1,340 meters (2,400–4,400 feet), but not seen on the east slope.

Mamillaria.

Owing to the uncertainty respecting the species of *Mamillaria* observed, our notes are of very little value. Representatives of the genus were found in the following localities in Nevada: Mountain Spring, Charleston Mountains; Great Bend of the Colorado River; Bitter Springs (where it was in flower May 5, flowers rich red); and on steep gravel slopes near the boundary between Arizona and Nevada on the west side of the Virgin Valley.

Yucca baccata. (Plate XII.)

This elegant yucca is by far the handsomest species growing in the desert regions of the Southwest, where it was found in the following localities:

NEVADA.

Charleston Mountains.—*Yucca baccata* was first seen on the west slope (Pahrump Valley side) of the Charleston Mountains, in the upper part of the tree yucca belt, at an altitude of about 1,430 meters (4,700 feet), whence it ranges up to the divide at Mountain Spring, a little less than 1,830 meters (or 6,000 feet), and down on the east side to 1,340 meters (4,400 feet), where it was mixed with *Yucca macrocarpa*. It was budding abundantly April 30, but only a few flowers had expanded.

Indian Spring Valley.—Tolerably common at the north end of the north arm of Indian Spring Valley at an altitude of about 1,400 meters (4,600 feet), whence it ranges up toward Hungry Hill Summit to 1,700 meters (5,600 feet), where it was flowering in great perfection May 27.

Timpahute and Desert Mountains.—Occurs sparingly in the neighborhood of Mud or Summit Spring.

Pahranagat Valley.—Occurs sparingly on the west side of the valley, beginning about a mile from the bottom at an altitude of 1,270 meters (4,200 feet) and ranging up to 1,400 meters (4,600 feet).

Hyko Mountains.—Occurs sparingly along the open cañon or wash leading from Pahroc Plain into Pahranagat Valley.

Pahroc Mountains.—Tolerably common near Pahroc Spring.

Highland Range.—Occurs sparingly on the west slope.

Juniper Mountains.—Found sparingly on the west slope of the Juniper Mountains between Panaca and Sheep Spring, at an altitude of 1,830 to 1,970 meters (6,000 to 6,500 feet). Here it was only in bud May 19, though it was in flower on the Beaverdam Mountains and on the south slope of Pine Valley Mountain, Utah, a week or ten days earlier.

UTAH.

Santa Clara Valley.—In the Upper Santa Clara Valley, north of St. George, this handsome species occurs in a belt a few miles wide, beginning at about 1,150 meters (3,800 feet) and reaching up to 1,460 meters (4,800 feet).

Beaverdam Mountains.—Common, ranging down to 1,080 meters (3,600 feet) on the east slope, and 1,030 meters (3,400 feet) on the west slope. It was beginning to flower May 10, though some plants were only in bud at that time.

Yucca arborescens [=*Yucca brevifolia*]. (Plate XIII and frontispiece.)

Among the many unusual and peculiar modifications of plant life of the desert regions of the southwestern United States, none is more remarkable or striking than the tree yucca (*Yucca arborescens*).

Tree yuccas form open forests or groves, usually of small size, but sometimes 15 or 20 miles or more in length, according to the extent of the area suitable to their requirements. The individual trees are well spaced and vary from 6 to 9 meters (20 to 30 feet) in height. They branch in a very peculiar manner and are abundantly clothed with stiff, spiny leaves set so near together that their bases are in actual contact. As the tree grows the leaves die from below upward, and the dead ones at first point outward at right angles to the trunk, and then downward, their points surrounding the branch or trunk like a belt of bayonets, effectually preventing most animals from climbing up from below. The dead leaves fall off after a year or two, so that the trunks and lower parts of the main branches finally become bare.

Tree yuccas are abundant about the borders of the Mohave Desert and on many of the included 'lost ranges,' and also in places of suitable elevation throughout the deserts of southeastern California, southern Nevada, western Arizona, and the extreme southwestern corner of Utah. They do not grow in the bottoms of the arid basins, or upon the steep declivities of the mountains, but thrive best on the higher gravel slopes that skirt the deserts and upon the basal slopes of the included desert ranges, always in a definite zone or belt the extreme vertical width of which rarely exceeds 450 meters (1,500 feet), and usually is much less. The altitude of this belt varies with the base level, but invariably marks the upper limit of the Lower Sonoran zone.

Looking northward over the Mohave Desert from the summit of Cajon

Pass a continuous forest of tree yuccas stretches away in the distance until lost in the desert haze, adding a singularly weird element to the peculiar physiognomy of the region.

Some years ago an attempt was made to make paper pulp from the trunks of tree yuccas. The attempt was successful so far as the production of good pulp was concerned, but the cost of manufacture proved greater than the projectors of the enterprise expected and it was abandoned. Mr. Charles H. Shinn, in an article in the American Agriculturist for December, 1891 (p. 689), states that a small pulp mill was built at Ravenna in Soledad Pass, just south of Mohave Desert in California (of which two figures are given), and that large quantities of paper were manufactured and shipped to England, on which a few editions of the London Daily Telegraph were printed. He states further that some of it was used in New York and in San Francisco.

The following detailed notes were recorded respecting the distribution of this species:

CALIFORNIA.

Mohave Desert.—Tree yuccas are common on the higher levels of the Mohave Desert, where they form a belt several miles in width around the west arm of the desert, covering the slope at the north foot of the San Bernardino range of mountains and stretching thence westerly nearly to the west end of Antelope Valley. On the north side of the desert they cover the slope at the foot of the Tehachapi Mountains and extend northeasterly in scattered patches nearly to Walker Pass, in which they again become abundant. This belt is not continuous throughout, but is interrupted by the absence of suitable conditions. Opposite Cajon Pass the forest is fully 20 kilometers (12 miles) in breadth, covering the slope between the altitudes of 730 and 1,180 meters (2,500 and 3,900 feet), though the trees are scarce and scattering below 920 meters (3,300 feet). Above 1,060 meters (3,500 feet) they are mixed with juniper, and between 1,150 and 1,180 meters (3,800–3,900 feet) with the true sagebrush (*Artemisia tridentata*). An isolated clump grows within the mouth of the pass on the south side of the divide at an altitude of 1,170 meters (3,850 feet). On the divide between Dagget and Pilot Knob they occur sparingly on the south side of the summit, but are more common on the long slope leading down to Paradise Valley from the south (north exposure), where a sparse growth continues for many miles. A few scattered and stunted trees were found also on and near the divide at Pilot Knob. On the north side of the Mohave Desert, just north of the town of Mohave, they begin at an altitude of 900 meters (3,000 feet) and extend up through the wash or open cañon leading to Tehachapi Valley, reaching Cameron at an altitude of 1,090 meters (3,600 feet). They range thence easterly a few miles, and westerly along the base of the Tehachapi Mountains as far as the eye can reach. They come down from the north side of the desert to within a mile of Mohave Station, and extend thence westerly and southwesterly over Antelope Valley with hardly a break between Mohave and Willow Spring, though they are absent from the dry flat extending from Willow Spring southerly and westerly. On the south side of the desert they reappear on a low ridge a few miles south of Mohave, and extend thence southerly past Lancaster to and into Soledad Pass. In the extreme western end of the Mohave Desert, known as Antelope Valley, they reach westward along the middle and north part of the valley to a point about 6 kilometers (4 miles) east of Liebre ranch, but on the south side (north slope) they do not extend quite so far west. They reappear in an open cañon or broad wash leading south from near Gorman's ranch to Peru Creek, where they occur in clumps and irregular patches for a mile or so at an altitude of 850 to 900 meters (2,800–3,000 feet).

Walker Pass.—At the east end of Walker Pass tree yuccas begin at 1,090 meters (3,600 feet) and form a fine forest in the pass, filling it all the way across up to 1,430 meters (4,700 feet), and straggling on singly and in little clumps up to and over the summit at 1,550 meters (5,100 feet) and down on the west side, with several interruptions, to the valley of Kern River. The total length of the yucca strip in the pass proper is 18 or 20 kilometers (11 or 12 miles). From Walker Pass they descend into Kern Valley, where a number of small interrupted groves are scattered irregularly along the bottom of the valley nearly all the way down to the forks of Kern River, at an altitude of 850 meters (2,800 feet).

Coso Mountains.—A yucca grove covers part of the west slope of the Coso Mountains, beginning about 5 kilometers (3 miles) south of Owens Lake and reaching thence southerly nearly to Haway Meadows. Its lower edge comes down almost to the level of the valley (probably to about 1,120 meters or 3,700 feet). A few scattering trees occur still further south, but they are not numerous enough to form a grove. [Dr. A. K. Fisher tells me that this grove spreads easterly over nearly the whole of the Coso mountains and valley.]

Panamint Mountains.—A few stunted tree yuccas occur on the west side of the divide between Perognathus Flat and Wild Rose Spring in the Panamint Mountains.

Nelson Range.—Mr. E. W. Nelson found tree yuccas in abundance on the low range (here named 'Nelson Range') separating Panamint Valley from Saline Valley, where they stretch all the way across from the Inyo Mountains to the Panamint Mountains.

Ivawatch Mountains.—Mr. T. S. Palmer found a few scattering trees on the southwest slope of the Ivawatch Mountains.

NEVADA.

Mount Magruder.—Tree yuccas occur sparingly on the northwest slope of Mount Magruder and adjacent hillsides from an altitude of 2,070 meters (6,800 feet) down almost to the upper level of Fish Lake Valley at

1,730 meters (5,700 feet). Another and better defined grove occupies the southeast base of Mount Magruder, facing the north part of Sarcobatus Flat.

Gold Mountain.—Tree yuccas occur sparingly in the valley between Mount Magruder and Gold Mountain at an altitude of 1,740 meters (5,700 feet) and range thence southerly over the south slope of Gold Mountain and adjacent hills, reaching westward almost to the edge of the northwest arm of Death Valley at 1,770 meters (5,800 feet), and occurring throughout the east and west trough or valley which occupies the north slope of Gold Mountain north of the Gold Mountain mining camp (also known as 'State Line'), reaching as high as 2,100 meters (7,000 feet) on south exposures on spurs and hills north of the main peak, though not occurring on the north slope of the main ridge proper. On the south side of Gold Mountain they descend to 1,550 meters (5,100 feet), thus reaching well down on the north side of Grapevine Cañon. Several were found in flower near the summit of Gold Mountain June 3, the only flowers of this species seen during the trip. They are sessile in dense clumps at the ends of the branches, and are coarser and less attractive than those of any of the other species.

Grapevine Mountains.—A yucca forest of considerable size occupies the east base of the Grapevine Mountains west of the southern half of Sarcobatus Flat.

Ralston Desert.—A forest of tree yuccas was seen on the north side of the east fork of Amargosa Creek northeast of the north end of Oasis Valley and is probably the northern limit of the species in this direction.

Table Mountain.—Mr. F. Stephens found a large forest of tree yuccas on the mesa known as 'Table Mountain,' about 40 kilometers (25 miles) north of Ash Meadows.

Timpahute and Desert Mountains.—Tree yuccas begin on the west side of Timpahute Desert at the very bottom of the east slope of the Timpahute Mountains (altitude 1,450 to 1,490 meters or 4,800 to 4,900 feet) and continue all the way to and over the summit of the saddle between the Timpahute and Desert Mountains (summit 1,750 meters or 5,750 feet). They do not occur immediately below Summit Spring, but soon reappear and reach down to Emigrant Valley at 1,580 meters (5,200 feet), forming a broad zone along the west slope of the Desert Range, whence they extend all the way around the south end of Emigrant Valley, and reach several miles north on the west side. Continuing southward without interruption they pass over the low divide at Hungry Hill Summit (1,760 meters or 5,800 feet) and extend down the narrow North Arm of Indian Spring Valley to 1,200 meters (4,000 feet), where they are sufficiently abundant most of the way to form a regular yucca forest. In the lower part many trees were in fruit May 27, bearing large green pods containing flat seeds.

Pahranagat Mountains.—Common on the Pahranagat Mountains from the summit of the pass between Pahranagat and Timpahute valleys (altitude 1,830 meters or 6,000 feet) down on the west side to the edge of Timpahute Desert at an altitude of 1,525 meters (5,000 feet), and down on the east side sparingly to within a mile of the bottom of Pahranagat Valley at an altitude of 1,280 meters (4,200 feet), and forming a fair forest above 1,400 meters (4,600 feet). Stunted and scattered trees stretch thence southerly all along the gravel slope on the west side of Pahranagat Valley at the foot of the Pahranagat Range. On the west slope of the Pahranagat Range (on the east side of Timpahute Valley) the trees are sufficiently near together to form a fair yucca forest between an altitude of 1,390 meters (4,600 feet) and the summit of the divide.

Highland Range.—The most northerly forest of tree yuccas found in eastern Nevada is on the west slope of the Highland Range south of the dry lake in Desert Valley, and southeast of Pahroc Spring. This forest is at least 5 miles wide and 10 miles long, and may stretch away much further to the south. Apparently it begins at an altitude of about 1,670 meters (5,500 feet) on the desert side, and ranges up to 2,000 meters or higher (probably to 6,500 or 7,000 feet) on the west slope of the mountains.

Pahroc Range.—A few scattering and stunted tree yuccas grow at Point of Rocks, the southernmost spur of the Pahroc Range near Pahroc Spring. These are the northernmost trees of which we have any knowledge. The high base level of Pahroc Plain explains the unusually high altitude at which they grow.

Charleston Mountains.—On the west slope of the Charleston Mountains (Pahrump Valley side), below Mountain Spring, tree yuccas begin at an altitude of about 1,060 meters (3,500 feet), and become more and more abundant until they form an open forest in the upper *Larrea* and *Coleogyne* belt, mixing with the junipers at 1,525 meters (5,000 feet), and pushing 60 to 90 meters (200 or 300 feet) higher on favorable slopes, finally stopping at an altitude of about 1,600 meters (5,300 feet). The individual trees are smaller than those of the Mohave Desert, rarely exceeding 4½ meters (15 feet) in height. In the lower part of this belt *Yucca arborescens* is mixed with unusually large examples of *Yucca macrocarpa*, and in the upper part with the elegant *Yucca baccata*.

ARIZONA.

Northwestern corner.—On the mesa west of the Virgin River and about 8 miles south of the mouth of Beaverdam Creek, near the boundary between Arizona and Nevada, is a scattering belt of tree yuccas a mile or a mile and a half in breadth, ranging from an altitude of about 670 meters (2,250 feet) on the Virgin Valley slope to the top of the mesa at 740 meters (2,450 feet).

Detrital Valley.—Mr. Vernon Bailey informs me that *Yucca arborescens* forms an extensive forest on the low divide between Detrital and

Sacramento Valleys, reaching northward along the sides of Detrital Valley for about 24 kilometers (15 miles) north of Mountain Spring.

UTAH.

Beaverdam Mountains.—Tree yuccas begin at the foot of the west slope of the Beaverdam Mountains in southwestern Utah at an altitude of about 700 meters (2,300 feet), and range up to 1,340 meters (4,400 feet), forming a belt 8 or 9 kilometers (5 or 6 miles) in width. The trees rarely exceed 3 meters (10 feet) in height and are more scattering than in the Mohave Desert.

Yucca elata?

A narrow-leaved yucca provisionally referred to this species was found sparingly in the Lower Santa Clara Valley, Utah, on the mesa near the town of St. George, where it was in full bloom and very handsome May 11–15. Its flower-stalks are tall and slender, and its leaves narrow and thin. A form resembling this, but with somewhat thicker and heavier leaves, was found on the west slope of the Juniper Mountains between Sheep Spring and Panaca, between the altitudes of 1,760 and 2,130 meters (5,800–6,700 feet). It was budding plentifully May 19, but was not found in flower.

Yucca macrocarpa. (Plate XIV.)

This large yucca was found in but few localities traversed by the expedition. It finds its western limit along with *Opuntia ramosissima* on the North Kingston Mountains, between Resting Springs and Pahrump Valley, Nevada. It begins again on the east side of Pahrump Valley at an altitude of about 970 meters (3,200 feet), and ranges up on the west slope of the Charleston Mountains to 1,090 meters (3,600 feet), forming a well-marked zone mixed with scattering trees of *Yucca arborescens*, which latter species becomes more and more abundant until it forms a true yucca forest in the upper *Larrea* and *Coleogyne* belt, where *Y. macrocarpa* disappears. In this zone *Yucca macrocarpa* grows larger than observed elsewhere, many plants reaching the height of 2½ meters (8 feet), and some growing as high as 3 or even 4 meters (10 to 13 feet). It never branches like *Yucca arborescens* but has a heavy, irregular trunk, well shown in the accompanying photograph. On warm soil a few plants were in full flower April 29, though most of them were not yet in bud. On the east side of the Charleston Mountains it begins at an altitude of 1,525 meters (about 5,000 feet), and descends to the upper part of Vegas Valley, near Cottonwood Springs, at an altitude of 900 meters (3,000 feet), where dozens were found in flower April 30.

On the north side of the Charleston Mountains this species occurs sparingly throughout the higher parts of Indian Spring Valley above 1,180 meters (3,900 feet). It is common on the low divide about 27½ kilometers (17 miles) west of Indian Spring at an altitude of 1,220 *meters* or 4,000 feet, and thence is continuous westerly along the south (or highest) side of the valley to the cañon separating Indian Spring Valley from the Amargosa country, and occurs scattering on the west or Amargosa side, skirting the higher slopes. In the north arm of Indian Spring Valley it is common and conspicuous, ranging from 1,370 meters (4,500 feet) northward to about 1,670 meters (5,500 feet). It was not found on the Beaverdam Mountains or in any other locality.

ARIZONA.

Detrital Valley.—Mr. Vernon Bailey informs me that he found this species abundant and of unusually large size throughout the south end of Detrital Valley and north end of Sacramento Valley, covering the divide and extending for some distance along the foothills of the bordering mountains.

Yucca whipplei.

This is the characteristic yucca of the Coast Ranges of California, whence it extends easterly along the west slope of the Sierra Nevada, where we found it flowering abundantly between Kernville and Walker Basin June 23, its creamy flowers on tall white stalks dotting the side-hills above the chaparral. It is common also in the Tehachapi Mountains, ranging down as low as 1,060 meters (3,500 feet) in the upper part of the cañon leading from Tehachapi to Mohave, and on the hills at the head of Antelope Valley, near Gorman's ranch (altitude about 1,150 meters or 3,850 feet), whence it spreads over the Sierra Liebre range.

Agave utahensis.

This species, the only true agave met with by the expedition, was found in but two localities, namely, the Charleston Mountains in Nevada and the Beaverdam Mountains in southwestern Utah. In the former locality it was common on rocky hillsides in the neighborhood of Mountain Spring, from an altitude of 1,600 meters (5,300 feet) up to 1,830 meters (6,000 feet), where many 'mescal' pits were found where the Indians had baked the edible butts of the plants. These pits average a little more than a meter (about 4 feet) in depth, and from 3½ to 6 meters (12 to 20 feet) in diameter. On the west slope of the Beaverdam Mountains in Utah the agave begins at 1,180 meters (3,800 feet) and grows in a narrow zone upward toward the summit of the pass.

LIST OF LOCALITIES VISITED BY THE DEATH VALLEY EXPEDITION.

By T. S. Palmer.

The delay in the appearance of the first part of the report, containing descriptions of the various points visited by the expedition, makes it desirable to furnish a brief statement concerning the places referred to. In describing an area like the desert region of California great difficulty is experienced in fixing localities, and recourse must often be had to cañons, washes, and springs for names with which to indicate places. For this reason a large number of seemingly unimportant localities occur in the report, which can be found on few, if any, published maps and are more or less meaningless to one unfamiliar with the country. The following list, while making no pretense to include all the localities mentioned in the report, gives brief descriptions of the more important places, which will serve to locate them with reference to well-known points. Many of these places will be described more fully elsewhere.

The altitudes have been compiled chiefly from Gannett's Dictionary of Altitudes in the United States* and the map sheets of the Wheeler Survey West of the 100th Meridian. These have been supplemented by observations made by the expedition; but except in the case of points in Death Valley (which were determined by a topographer of the U. S. Geological Survey), such altitudes are based mainly on observations made with aneroid barometers. Since the list is intended primarily as a help in finding places on the map, distances, unless otherwise stated, indicate the number of miles measured in a straight line between two points, and not the distance by the road. In the case of railroad points, however, the distances between stations are taken from the railroad figures. This will explain the apparent discrepancy in many cases between the distances given and the actual distances as measured by an odometer. The metric equivalents for altitudes and distances are only approximate, all fractions having been discarded in converting the measurements into the metric system. Under each locality will be found the names of the members of the expedition who visited it and

* Bull. U. S. Geol. Survey, No. 76, 1891.

who assisted in making the collections described in this report.† A list of several names under one locality usually indicates that the place was visited by different members at different dates—particularly in the case of points in Death Valley, Owens Valley, and the Sierra Nevada.

NOTE.—Reference letters and figures follow names of places which appear on the accompanying map. Altitudes based on observations made by the expedition are marked with an asterisk.

Adobe Station, Kern County, Calif. Altitude, 284 feet (86 meters).

An abandoned stage station on the wagon road from Bakersfield to Los Angeles, situated northeast of Kern Lake in the San Joaquin Valley .... NELSON.

Alila, Tulare County, Calif. Altitude, 280 feet (85 meters).

A station on the Southern Pacific Railroad, 30 miles (48 kilometers) south of Visalia .... BAILEY, FISHER, NELSON.

Alvord, Inyo County, Calif. Altitude, 3,956 feet (1,206 meters).

The station on the Carson and Colorado Railroad for Big Pine, 54 miles (86 kilometers) north of Keeler on Owens Lake .... STEPHENS.

Amargosa Borax Works, Inyo County, Calif. F, 12.

An abandoned station and borax works of the Pacific Coast Borax Company, situated on the Amargosa River, about 20 miles (32 kilometers) north of the Great Bend and 6 miles (10 kilometers) west of Resting Springs.

PALMER, BAILEY, FISHER, NELSON.

Amargosa Range, Inyo County, Calif. D–E, 11.

The name given to the central part of the range which forms the eastern wall of Death Valley. It is usually restricted to that portion of the range between Boundary Cañon on the north (beyond which are the Grapevine Mountains), and Furnace Creek on the south, which marks the beginning of the Funeral Mountains. The highest point, Pyramid Peak, has an altitude of 6,754 feet, or 2,058 meters. (See also Funeral Mountains.)

Amargosa River. D–F, 11–12.

A 'stream' (usually nothing more than a dry wash) running from Oasis Valley, Nevada, southward through Ash Meadows to the end of the Funeral Mountains, where it turns at the 'Great Bend' to the west and northwest and sinks in Death Valley.

Antelope Valley, Los Angeles County, Calif. H, 7–8.

The name applied to the western part of the Mohave Desert immediately north of the Sierra Liebre .... MERRIAM, PALMER.

Argus Mountains, Inyo County, Calif. E–F, 10.

The range situated immediately west of Panamint Valley between the Coso and Panamint mountains. Its highest point, Maturango Peak, has an altitude of 8,844 feet (2,696 meters) .... PALMER, FISHER.

† Mr. Albert Koebele, the entomologist, joined the expedition at Daggett on April 3, and remained only about six weeks. He crossed the Mohave Desert to Death Valley with one of the parties and then proceeded to Keeler by way of Panamint Valley, Shepherd Cañon, and Darwin, making collections along the road wherever practicable. He visited Daggett, Paradise Valley, Granite Wells, and Lone Willow Spring in San Bernardino County; Furnace Creek, Bennett, and Mesquite Wells in Death Valley; Windy Gap; Hot Springs in Panamint Valley; Shepherd Cañon and Maturango Spring in the Argus Mountains; Darwin and Keeler.

Ash Creek, Inyo County, Calif. E, 8.

A small stream entering Owens Lake from the west, about 9 miles (14 kilometers) north of Olancha. Named from the ash trees that grow on its borders...STEPHENS.

Ash Meadows, Nye County, Nev. E, 11-12.

The large valley or plain east of the Amargosa Range and 50 miles (80 kilometers) north of the Great Bend of the Amargosa River, named on account of the presence of a small desert ash (*Fraxinus coriacea*) which was formerly abundant. The boundary line between California and Nevada passes through Ash Meadows. Collections were made by Merriam, Bailey, and Stephens at the 'King Spring' or 'Stone House' (altitude about 3,800* feet or 1,160 meters), on the eastern side of the valley, and by the rest of the party at Watkins' Ranch, 3 or 4 miles west of this point—all in Nevada.

Bakersfield, the county seat of Kern County, Calif. Altitude, 415 feet (126 meters). G, 6..........................MERRIAM, PALMER, NELSON, FISHER, BAILEY.

Banning, San Bernardino County, Calif. Altitude, 2,317 feet (706 meters).

A station on the Southern Pacific Railroad, about 30 miles (50 kilometers) southeast of San Bernardino and near the summit of the San Gorgonio Pass........STEPHENS.

Beaverdam Mountains, Washington County, Utah. C, 17.

A north-and-south range west of the town of St. George, constituting the northward extension of the Virgin Mountains........................MERRIAM, BAILEY.

Bennett Wells, Inyo County, Calif. Altitude, 323* feet (98 meters) below sea level. E, 11.

Two shallow wells dug in the bottom of Death Valley, on the west side of the salt marsh, and nearly due east of Telescope Peak. Named in memory of one of the survivors of the ill-fated party of emigrants who entered the valley in 1850. The lowest point in the valley (480* feet or 146 meters *below sea level*, according to observations of the U. S. Geological Survey) is a little northeast of this place.
MERRIAM, PALMER, FISHER, NELSON, BAILEY.

Benton, Mono County, Calif. Altitude, 5,515 feet (1,681 meters). B, 8.

A station on the Carson and Colorado Railroad, 100 miles (160 kilometers) north of Keeler. The town is about 4 miles (6 kilometers) west of the station of the same name, and about 200 feet (60 meters) higher ....NELSON, STEPHENS.

Big Cottonwood Meadows, Inyo County, Calif. Altitude about 10,000* feet (3,050 meters).

The large meadows near the head of Big Cottonwood Creek, a stream rising near Mount Corcoran, and flowing into Owens Lake. A meteorological station was established in the meadow (about 8 miles or 13 kilometers southeast of Mount Whitney) June 15, and observations were continued by Dutcher and Koch until September 15..............................MERRIAM, PALMER, FISHER, BAILEY, NELSON.

Big Pine, Inyo County, Calif. Altitude, about 4,000 feet (1,220 meters). C, 8.

A town in Owens Valley, about 50 miles (80 kilometers) north of Owens Lake. (See also Alvord)..................................MERRIAM, BAILEY, NELSON.

Big Tree Cañon, Tulare County, Calif.

A cañon on the East Fork of the Kaweah, named on account of the presence of Big Trees (*Sequoia gigantea*)..BAILEY.

Bishop, Inyo County, Calif. Altitude [of station], 4,104 feet (1,251 meters). C, 8.

A station on the Carson and Colorado Railroad, about 70 miles (113 kilometers) north of Keeler. The town of Bishop, or Bishop Creek, is on the creek of the same name, and is west of the station...............................NELSON, STEPHENS.

Bishop Creek, Inyo County, Calif. C, 8.

A small stream rising on the east slope of the Sierra Nevada and flowing into Owens River. Collections were made by Stephens at Lewis Lake on the west fork of the creek at an altitude of about 9,000 feet (2,740 meters) .... STEPHENS.

Bitter Spring, Lincoln County, Nev. Altitude, 1,800–1,900* feet (550–580 meters). E, 15.

A spring on the east slope of the Muddy Mountains, about 16 miles (25 kilometers) northeast of the site of Callville .... MERRIAM, BAILEY.

Borax Flat or Lake, San Bernardino County, Calif. Altitude, 1,808 feet (551 meters). F, 10.

A borax marsh on the boundary line between San Bernardino and Inyo counties, just west of the Slate Range and near the southern end of the Argus Range, about 25 miles (40 kilometers) west of Browns Peak. Searles' borax works are located on the northwest side of the marsh .... STEPHENS.

Browns Peak, Calif. Altitude, 5,392 feet (1,643 meters). F, 10.

A prominent peak opposite the south end of the Panamint Range and east of Lone Willow Spring .... BAILEY.

Bubbs Creek, Fresno County, Calif.

The main branch of the South Fork of Kings River, which rises near Kearsarge Pass and unites with the South Fork at the east end of the Kings River Cañon.

PALMER, FISHER, NELSON.

Bunkerville, Lincoln County, Nev. D, 16.

A Mormon town in the Virgin Valley on the road from Callville, Nev., to St. George, Utah, 5 miles (8 kilometers) west of the eastern boundary of the State of Nevada .... MERRIAM, BAILEY.

Cajon Pass, San Bernardino County, Calif. Altitude [of wagon pass], 4,195 feet (1,279 meters). I, 9–10.

A pass in the Sierra Madre, leading north from the San Bernardino Valley to the Mohave Desert .... MERRIAM, PALMER, FISHER, STEPHENS.

Caliente, Kern County, Calif. Altitude 1,290 feet (393 meters). G, 7.

A station and post-office on the Southern Pacific Railroad at the north foot of Tehachapi Pass .... MERRIAM, PALMER.

Callville, Lincoln County, Nev. Altitude, 915 feet (288 meters). E, 15.

An abandoned Mormon settlement on the north bank of the Colorado River at the head of navigation and about 4 miles (6 kilometers) east of the Great Bend.

MERRIAM, BAILEY.

Cameron, Kern County, Calif. Altitude 3,786 feet (1,154 meters).

A station on the Southern Pacific Railroad, 10 miles (16 kilometers) northwest of Mohave and 6 miles (10 kilometers) southeast of Tehachapi..... MERRIAM, PALMER.

Cañada de las Uvas, Kern County, Calif. Altitude about 4,288 feet (1,307 meters). H, 7.

A wagon pass in the Tejon or Tehachapi mountains, leading from the south end of the San Joaquin Valley across to the west end of the Mohave Desert. Situated east of Mt. Piños and about 30 miles (50 kilometers) southwest of Tehachapi Pass.

MERRIAM, PALMER, NELSON.

Canebrake Ranch, Kern County, Calif. Altitude 3,904 feet (1,190 meters).

A ranch at the northwest foot of Walker Pass on the road from Kernville to Coyote Holes .... MERRIAM, PALMER, FISHER, BAILEY.

Carpenteria, Santa Barbara County, Calif. I, 5.

A town on the Southern Pacific Railroad, 10 miles (16 kilometers) east of Santa Barbara .... NELSON.

Carrizo Plains, San Luis Obispo County, Calif. G, 4-5.

The name given to the valley or plain east of the headwaters of the San Juan River and separated from the main San Joaquin Valley by the low ridge of the Temploa Mountains .... NELSON.

Castac Lake, Kern County, Calif. H, 7.

A small lake in the Cañada de las Uvas, 2 miles (3 kilometers) south of Old Fort Tejon, but in the San Joaquin drainage† .... MERRIAM, PALMER.

Cave Wells, Calif., commonly known as the 'The Caves.' F, 12.

A spring and abandoned stage station in the Ivawatch Mountains, about 15 miles (24 kilometers) south of Saratoga Springs in Death Valley. The spring is on the main road from Daggett to Resting Springs .... PALMER, STEPHENS.

Centerville, Fresno County, Calif.

A town on Kings River in the western foothills of the Sierra, about 20 miles (32 kilometers) east of Fresno .... NELSON.

Charcoal Kilns, Inyo County, Calif. Altitude about 7,500* feet (2,286 meters).

A number of abandoned charcoal kilns on the west slope of the Panamint Mountains, in the upper part of Wild Rose Cañon, about 7 miles (11 kilometers) above the spring of the same name .... MERRIAM, FISHER, BAILEY, STEPHENS.

Charleston Mountains, Lincoln County, Nev. E-F, 13-14.

A high range of mountains, marked Spring Mountains on the Land Office and some other maps. The culminating point, Charleston Peak, has an elevation of 10,874 feet (3,314 meters), and is the highest peak in southern Nevada. Collections were made by Nelson and Palmer at a saw mill (altitude about 8,000* feet or 2,438 meters) on the west slope northwest of the main peak, and by Merriam and Bailey at Mountain Spring (altitude 5,501 feet or 1,677 meters), at the southern end of the range on the road from Pahrump Valley to Las Vegas Ranch.

Chiquito Peak, Fresno County, Calif. Altitude 8,136 feet (2,480 meters). C, 6.

A peak on the west slope of the Sierra Nevada, south of Mount Lyell.

Chiquito San Joaquin or **Chiquito Creek**, Fresno County, Calif.

A small stream in the High Sierra, which rises southeast of Mount Raymond and, flowing southward, enters the San Joaquin River a little below the mouth of the South Fork .... NELSON.

Corn Creek, Lincoln County, Nev.

A spring in the Vegas Valley, about 25 miles (40 kilometers) northwest of Las Vegas Ranch .... BAILEY, NELSON.

Coso, Inyo County, Calif. Altitude about 5,800 feet (1,768 meters). E, 9.

A deserted mining camp, about 7 miles (11 kilometers) southwest of Darwin. The camp is situated at the head of a rocky cañon, about 3 miles (5 kilometers) southeast of the peak of the same name .... PALMER, FISHER.

Coso Mountains, Inyo County, Calif. E, 9.

A range southeast of Owens Lake, between the Sierra Nevada and the Argus Range. Its highest point, Coso Peak, has an altitude of 8,425 feet (2,568 meters).

PALMER, FISHER.

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†On some maps the name Castac Lake is given to a lake in the Mohave Desert, south of the divide in the Cañada de las Uvas.

Cottonwood Cañon, Inyo County, Calif. D. 10.

A cañon in the northern part of the Panamint Mountains, leading from the southern part of Saline Valley to the northwestern arm of Death Valley or Mesquite Valley .... NELSON.

Cottonwood Springs, Lincoln County, Nev. Altitude of lower spring 3,449 feet (1,051 meters). E, 14.

(1) Upper Cottonwood Springs. A series of running springs at the east base of the Charleston Mountains, about 7 miles (11 kilometers) northeast of Mount Olcott. MERRIAM, BAILEY, NELSON.

(2) The lower spring (the Cottonwood Spring of the Wheeler survey) is in a gap in a low range of hills between the Charleston Mountains and Vegas Valley, some distance east of the upper springs .... MERRIAM, BAILEY, NELSON.

Coyote Holes, Calif.

A name commonly applied to small springs or 'tanks' of water on the desert whether fresh or alkaline.

(1) Kern County. Altitude 3,368 feet (1,027 meters).

A spring and ranch on the Mohave and Keeler stage road, just south of the entrance to Walker Pass; also known as Freeman Post-Office .... PALMER, STEPHENS.

(2) San Bernardino County. G, 11.

An alkaline spring on the Daggett and Resting springs road, 19 miles (30 kilometers) by the road northeast of Daggett .... PALMER, STEPHENS.

Crane Lake, Los Angeles County, Calif.

A small lake 2 miles (3 kilometers) southeast of Gorman Station, in the extreme west end of Antelope Valley .... MERRIAM, PALMER.

Crocker's Ranch, California. Altitude 4,497 feet (1,371 meters).

A station on the Big Oak Flat and Yosemite Valley stage road, 23 miles (37 kilometers) northwest of the Yosemite Valley (by the road). It is near the boundary line between Tuolumne and Mariposa counties, and 2 miles (3 kilometers) west of Hodgdon, the nearest point given on the Wheeler map sheet No. 56 D.

Cuddy Peak, California. (See Frazier Mountain.)

Daggett, San Bernardino County, Calif. Altitude 2,002 feet (610 meters). H, 11.

A town on the Atlantic and Pacific Railroad, 9 miles (14 kilometers) east of Barstow. Daggett is the base of supplies for the town of Calico and the Death Valley region .... MERRIAM, PALMER, FISHER, STEPHENS.

Darwin, Inyo County, Calif. Altitude 4,840 feet (1,475 meters). E, 9.

A small town 22 miles (35 kilometers) southeast of Keeler. Formerly an important mining camp .... PALMER, FISHER, BAILEY, NELSON.

Death Valley, Inyo County, Calif. D–F, 10–11.

The valley lying between the Panamint Mountains on the west and the range on the east known by the names of the Funeral, Amargosa, and Grapevine mountains. There are several springs of drinkable water in the valley, of which the most important are Saratoga Springs (altitude 352* feet, or 107 meters) at the southeast end, Bennett Wells (altitude 323* feet, or 98 meters, *below sea level*) on the west side, and the springs near the mouth of Furnace Creek, in the northern part of the Funeral Mountains. Death Valley proper extends from the vicinity of Saratoga Springs to a point about 10 miles (16 kilometers) north of Furnace Creek; but with the northwest arm, or Mesquite Valley, it has an extreme length of about 135 miles (215 kilometers). It is chiefly remarkable for its depth; observations taken by the U. S. Geological

Survey show that the lowest point northeast of Bennett Wells is 480* feet (146 meters) *below sea level*, thus making the valley the deepest depression in North America.
MERRIAM, PALMER, FISHER, BAILEY, NELSON, STEPHENS.

Death Valley Cañon, Inyo County, Calif.

A cañon on the east slope of the Panamint Mountains, leading down into Death Valley. The head of the cañon is about 10 miles (16 kilometers) north of Telescope Peak. An Indian trail from Darwin to Furnace Creek, after crossing the Panamint Valley, ascends Wild Rose Cañon and crosses the summit of the Panamint Mountains to the head of Death Valley Cañon........................BAILEY, FISHER.

Deep Spring Valley, Inyo County, Calif. C, 8-9.

A basin about 10 miles (16 kilometers) long, in the White Mountains near the Nevada boundary, and between Fish Lake and Owens valleys...MERRIAM, BAILEY.

Delano, Kern County, Calif. Altitude 313 feet (95 meters). F, 6.

A station on the Southern Pacific Railroad, 32 miles (51 kilometers) north of Bakersfield...BAILEY, FISHER, NELSON.

Desert Range, Lincoln County, Nev. C-D, 14.

A range north of the Charleston Mountains, inclosing the north arm of Indian Spring Valley. The Desert Range is the southern continuation of the Timpahute Mountains.

Desert Valley, Lincoln County, Nev. B, 15.

A narrow valley containing a large dry lake, between the Pahroc Range on the west and the Highland Range on the east, which latter separates it from the town of Panaca. A second Desert Valley is given on the Land Office map of Nevada just east of the Desert Range and some distance southwest of the one just described. The latter is the Timpahute Valley of the present report.........MERRIAM, BAILEY.

Diamond Valley, Utah.

A small valley in the southwestern part of the Territory, south of Pine Valley Mountain and north of St. George..............................MERRIAM, BAILEY.

Diaz Meadows, Inyo County, Calif. (See Big Cottonwood Meadows.)

Dolan Spring, Mohave County, Ariz. F, 16.

A spring on the east side of Detrital Valley, about 50 miles (80 kilometers) northeast of The Needles, Calif. Collections were made here in 1889 by.........BAILEY.

Elizabeth Lake, Los Angeles County, Calif. Altitude 3,317 feet (1,011 meters). H, 8.

A body of brackish water, a mile long and about one-half mile wide (1.6 by .8 kilometers), situated on the north side of the Sierra Liebre, 2 or 3 miles (3 to 5 kilometers) from the north end of the San Francisquito Pass...............PALMER.

Elk Bayou, Tulare County, Calif.

A small stream emptying into the Tulare River. Collections were made near the line of the Southern Pacific Railroad, about 6 miles (10 kilometers) south of the town of Tulare..BAILEY, FISHER.

Emigrant Cañon, Inyo County, Calif. D—E, 10.

A cañon in the Panamint Mountains, about 10 miles (16 kilometers) north of Wild Rose Cañon, and 15 or 20 miles (24 to 32 kilometers) north of Telescope Peak. Emigrant Cañon heads in Perognathus Flat and opens into the northwest arm of Death Valley...MERRIAM, BAILEY, STEPHENS.

Emigrant Spring, Inyo County, Calif. Altitude about 4,400* feet (1,340 meters). E, 10.

A spring, in a cañon of the same name, in the Panamint Mountains. There are two springs, about one-half mile apart, both on the west side of the cañon.
MERRIAM, BAILEY, STEPHENS.

Emigrant Valley, Nev. C, 13.

A small valley containing a dry lake. It is on the boundary line between Nye and Lincoln counties and west of the Desert and Timpahute mountains.
MERRIAM, BAILEY.

Escalante Desert, Utah. B, 17–18.

An extensive desert in southwestern Utah, north of Pine Valley Mountain and south of Sevier Lake........MERRIAM, BAILEY.

Farewell Gap, Tulare County, Calif. Altitude about 11,000* feet (3,350 meters).

A pass from the headwaters of the East Fork of the Kaweah River above Mineral King to the head of Little Kern River........PALMER, BAILEY, FISHER, NELSON.

Fish Lake Valley, Esmeralda County, Nev. B, 8–9.

On the boundary line between California and Nevada, lying mainly in the latter State, between the White Mountains on the west and the Silver Peak Mountains on the east........MERRIAM, BAILEY.

Fish Slough, Owens Valley, California.

An old stage station at several large springs on the road from Bishop Creek to Benton, near the boundary line between Inyo and Mono counties; about 11 miles (18 kilometers) north of Bishop Creek........STEPHENS.

Fort Miller, Fresno County, Calif.

An abandoned military post on the San Joaquin River, about 20 miles (32 kilometers) northeast of Fresno.

Fort Tejon, Kern County, Calif. Altitude 3,245 feet (989 meters). H, 7.

An abandoned military post situated in the Cañada de las Uvas, 4 miles (6 kilometers) from the north entrance of the cañon........MERRIAM, PALMER.

Frazier Mountain, Ventura County, Calif. Altitude 7,750 feet, or 2,362 meters (Rothrock). H, 7.

A high peak 10 miles (16 kilometers) southeast of Mount Piños. Also known as Cuddy Peak, and this name appears on map sheets Nos. 73 and 73C of the Wheeler Survey........PALMER.

Fresno, the county seat of Fresno County, Calif. Altitude 294 feet (90 meters). D, 5........BAILEY.

Funeral Mountains, Inyo County, Calif. E–F, 11-12.

A barren range, forming the eastern boundary of Death Valley and separating it from the Amargosa Desert. The Grapevine, Amargosa, and Funeral mountains form a continuous range from Mount Magruder south to Saratoga Springs, the name Funeral Mountains being given to the southern end of the range south of Furnace Creek. The highest peaks in the Funeral Mountains are Le Conte, 6,580 feet (2,005 meters); Mount Smith, 6,300 feet (1,920 meters); and Mount Perry, 5,500* feet (1,676 meters). Pyramid Peak (altitude 6,754 feet or 2,058 meters) is more properly in the Amargosa Range........PALMER, FISHER, BAILEY.

Furnace Creek, Death Valley, California. E, 11.

A small stream entering the east side of Death Valley from a cañon of the same name in the northern part of the Funeral Mountains. A mile or two from the mouth of the cañon is the 'Greenland ranch' of the Pacific Coast Borax Company, which is supplied by water from Furnace Creek. The altitude of the ranch is said to be about 200* feet (61 meters) *below sea level*. Collections were made here by
MERRIAM, FISHER, PALMER, BAILEY, NELSON, STEPHENS.

Garlick Spring, San Bernardino County, Calif. G, 11.

A spring of good water in the Mohave Desert, on the Daggett and Resting Springs road, 25 or 30 miles (40 or 48 kilometers) northeast of Daggett...PALMER, STEPHENS.

Gaviota Pass, Santa Barbara County, Calif. H-I, 4.

A pass in the Santa Yñez Mountains about 30 miles (48 kilometers) northwest of Santa Barbara, running north from the coast to the Santa Yñez Valley.....NELSON.

Giant Forest, Tulare County, Calif.

The most extensive grove of *Sequoia gigantea*. It is in the Sequoia National Park, on the divide between the Marble and East Forks of the Kaweah River and 5 to 10 miles (8 to 16 kilometers) south of Mount Silliman................PALMER, FISHER.

Gold Mountain, Esmeralda County, Nev. Altitude 7,400* feet (2,255 meters). C, 10.

A high east-and-west ridge at the northern end of the Grapevine Mountains, from which it is separated by a broad, open cañon (Grapevine Cañon), about 20 miles (32 kilometers) northwest of Grapevine Peak..................MERRIAM, BAILEY.

Gorman Station, Los Angeles County, Calif. Altitude 3,838 feet (1,170 meters). H, 7.

A post-office on the wagon road from Bakersfield to Los Angeles, just south of the summit of the divide in the Cañada de las Uvas.................MERRIAM, PALMER.

Granite Mountains, San Bernardino County, Calif. G, 10-11.

A low east-and-west range in the Mohave Desert lying south of the Slate and Panamint ranges. At the eastern end it runs into the Ivawatch Mountains, and on the west terminates in Pilot Knob or Granite Mountain, the altitude of which is 5,525 feet (1,683 meters)..................................PALMER, STEPHENS.

Granite Wells, San Bernardino County, Calif. Altitude, about 4,200* feet (1,280 meters).

A spring in the Mohave Desert on the northwest slope of Pilot Knob or Granite Mountain, 40 or 45 miles (64 to 72 kilometers) northwest of Daggett, on the wagon road to Death Valley.............................MERRIAM, PALMER, FISHER.

Grapevine Peak, Esmeralda County, Nev. Altitude, 8,657 feet (2,638 meters). D, 10.

The highest peak of the Grapevine Mountains, which lie along the California-Nevada boundary, separating the northwestern arm of Death Valley from Sarcobatus Flat and the Ralston Desert. The peak is about 15 or 20 miles (24 or 32 kilometers) south-southeast of Gold Mountain................................NELSON.

Grapevine Spring, Inyo County, Calif. C, 10.

A spring in the northwestern arm of Death Valley, on the western slope of the Grapevine Mountains, 5 miles (8 kilometers) west of Grapevine Peak, and on the California side of the line.......................................STEPHENS.

Greenland Ranch, Calif. (See Furnace Creek.)

Halsted Meadows, Tulare County, Calif. Altitude, about 7,000* feet (2,134 meters).

A small meadow in the Sequoia National Park, 6 or 8 miles (10 or 13 kilometers) southwest of Mount Silliman.................................FISHER, PALMER.

Havilah, Kern County, Calif. Altitude 3,150 feet (959 meters). F, 8.

A town and post-office about 15 miles (24 kilometers) south of Kernville, on the road to Caliente.........................MERRIAM, PALMER, BAILEY, FISHER.

Haway Meadows, Inyo County, Calif. Altitude, 3,782 feet (1,152 meters). E, 9.

A ranch and stage station on the Mohave and Keeler stage road, about 9 miles (14 kilometers) south of Olancha and 10 miles (16 kilometers) south of Owens Lake.
MERRIAM, PALMER, BAILEY, STEPHENS, FISHER.

Hesperia, San Bernardino County, Calif. Altitude, 3,184 feet or 969 meters (S. C. Ry.). I, 10.

A town on the Southern California Railway, just north of Cajon Pass and 36 miles (58 kilometers) north of San Bernardino ... MERRIAM, PALMER, FISHER, STEPHENS.

Hockett Trail, California.

An old military trail from Visalia, Tulare County, to Lone Pine, Inyo County. The main trail runs up the South Fork of the Kaweah River, thence across the divide and up the North Fork to Soda Springs, where it follows Whitney Creek to Big Cottonwood Meadows; from this point it descends the steep eastern slope of the Sierra to Lone Pine. A side trail runs from Mineral King through Farewell Gap to the head of Little Kern River and strikes the old trail near Trout Meadows.

PALMER, BAILEY, FISHER, NELSON.

Horse Corral Meadows, Fresno County, Calif. Altitude, about 8,000* feet (2,438 meters).

A small meadow on the trail from Camp Badger to Kings River Cañon, situated north of Mount Silliman .... PALMER, FISHER.

Hot Springs, Inyo County, Calif. E, 10.

Warm springs on the east side of Panamint Valley, near the mouth of Surprise Cañon .... MERRIAM, BAILEY, FISHER, NELSON, STEPHENS.

Hot Springs Valley, Inyo County, Calif. E, 9.

This name is applied to the northern end of Salt Wells Valley, which lies about 10 or 15 miles (16 or 24 kilometers) southwest of Coso Peak ...... PALMER, STEPHENS.

Hungry Hill Summit, Lincoln County, Nev. C, 13.

A divide in the Desert Mountains between Emigrant Valley and the head of the north arm of Indian Spring Valley .... MERRIAM, BAILEY.

Independence, county seat of Inyo County, Calif. D, 8.

The station on the Carson and Colorado Railroad (26 miles or 42 kilometers north of Keeler, at an altitude of 3,718 feet or 1,133 meters), is about 2 or 3 miles (3 to 5 kilometers) east of the town. Old Camp Independence, an abandoned military post, was located about 2 miles (3 kilometers) north of the town.

MERRIAM, BAILEY, PALMER, FISHER, NELSON, STEPHENS.

Independence Creek, Inyo County, Calif.

A small stream on the east slope of the Sierra Nevada, which rises on the east slope of Kearsarge Pass and flows into Owens River near Independence.

PALMER, FISHER, NELSON, STEPHENS.

Indian Spring Valley, Lincoln County, Nev. D, 13.

A narrow east-and-west valley north of the Charleston Mountains, with a north arm west of the Desert Range .... MERRIAM, BAILEY, NELSON.

Indian Wells, Kern County, Calif. Altitude, 2,608 feet (795 meters). F, 9.

A stage station on the road from Mohave to Keeler, near the southeast entrance to Walker Pass .... MERRIAM, PALMER, FISHER, BAILEY, STEPHENS.

Inyo Mountains, Inyo County, Calif. C–D, 8–9.

The first of the desert ranges east of the Sierra Nevada, forming the eastern wall of Owens Valley. Remarkable for its height and the steepness of its slopes. The name Cerro Gordo Range is sometimes given to the southern part of these mountains; but the Cerro Gordo, Inyo, and White mountains practically form one continuous range. The highest points are Waucoba Peak (altitude, 11,267 feet, or 3,403 meters), Mount Hahn (altitude, 11,030 feet, or 3,362 meters), and New York Butte (altitude, 10,675 feet, or 3,254 meters) .... NELSON.

Jackass Spring, Inyo County, Calif. Altitude, 6,489 feet (1,977 meters).

A spring on the west slope of the Panamint Mountains, at the point where Nelson Range joins the Panamint Mountains, not far from the entrance to Cottonwood Cañon...NELSON.

Johnson Cañon, Inyo County, Calif.

A cañon on the east slope of the Panamint Mountains, opening into Death Valley. Collections were made here by Fisher and Nelson 6 or 8 miles (10 or 13 kilometers) southeast of Telescope Peak, at altitudes varying from 5,000 to 9,000 feet (1,524 to 2,743 meters)..............................PALMER, BAILEY, FISHER, NELSON.

Juniper Mountains, Lincoln County, Nev. B, 16.

A north-and-south range between Meadow Valley, Nevada, and the Escalante Desert, Utah..MERRIAM, BAILEY.

Kaweah Peak, Tulare County, Calif. Altitude, about 14,000 feet (4,267 meters). D, 8.

The highest peak in the western ridge of the southern Sierra Nevada west of Mount Whitney.

Kaweah River, Tulare County, Calif. D–E, 6–7.

An important stream whose five main branches (the North, Marble, Middle, East, and South Forks) drain the west slope of the Sierra south of the basin of Kings River, and uniting near Three Rivers flow into Tulare Lake.

PALMER, BAILEY, FISHER, NELSON.

Kaweah Sawmill, Tulare County, Calif.

A sawmill about 15 or 20 miles (24 or 32 kilometers) north of Three Rivers, on the divide between the North and Marble Forks of the Kaweah River. The mill is at the lower edge of the pine forest and just within the western boundary of the Sequoia National Park. An excellent wagon road leads to it from Three Rivers.

PALMER, FISHER.

Kearsarge Pass, California. Altitude, about 12,000 feet (3,658 meters). D, 8.

One of the highest passes in the Sierra Nevada, crossing the range just south of Mount Kearsarge. The trail from Fresno to Independence runs through this pass.

PALMER, FISHER, NELSON.

Keeler, Inyo County, Calif. Altitude 3,622 feet (1,103 meters). E, 9.

A town on the east shore of Owens Lake. The present terminus of the Carson and Colorado Railroad.......MERRIAM, PALMER, BAILEY, FISHER, NELSON, STEPHENS.

Keene, Kern County, Calif. Altitude 2,705 feet (824 meters).

A station on the Southern Pacific Railroad, between Caliente and Tehachapi, about 12 miles (19 kilometers) below the summit of the pass.........MERRIAM, PALMER.

Kern River, California. E–G, 6–8.

A large river draining the trough between the two ridges of the southern Sierra Nevada. The South or East Fork rises on the west slope of Olancha Peak and flows south, then turning to the west, unites near the town of Kernville with the North or West Fork, which heads near Mount Whitney. The main river flows into Kern Lake. It was named by Fremont in honor of Edward M. Kern, topographer of the third Fremont expedition.

(1). Head of North Fork, Tulare County, Calif.

Specimens so labeled were collected in the basin between Mount Whitney and Kaweah Peak (altitude 9,000 to 12,000 feet, or 2,743 to 3,658 meters) north of Soda Springs and the cañon of the North Fork..............PALMER, BAILEY, DUTCHER.

(2) South Fork, California.

This locality refers to a camp near the northwest base of Walker Pass and 25 miles (40 kilometers) above Kernville, on the road to Coyote Holes.
MERRIAM, PALMER, BAILEY, FISHER.

Kern River Lakes, California. (See Soda Springs.)

Kernville, Kern County, Calif. Altitude 2,551 feet (777 meters). F, 8.

A small town near the junction of the North and South forks of Kern River.
MERRIAM, PALMER, BAILEY, FISHER.

Kings River, Fresno County, Calif. C–E, 5–7.

This river drains the west slope of the Sierra between the basins of the San Joaquin and the Kaweah Rivers. Its branches rise near the crest of the range between Mounts Brewer and Goddard and flow southwest into the San Joaquin River.

Kings River Cañon, Fresno County, Calif. Altitude 4,500 to 5,000 feet (1,371 to 1,524 meters).

The main cañon on the South Fork of Kings River, about 10 miles (16 kilometers) in length. . . . . PALMER, FISHER, NELSON.

Kingston Peak, San Bernardino County, Calif. F, 13.

A peak in the northeastern part of the county near the boundary between California and Nevada, and about 45 miles (72 kilometers) southwest of Charleston Peak, Nevada.

Lake Charlotte, Fresno County, Calif. D, 8.

A small lake near timber-line in the High Sierra on the trail from Kings River Cañon to Independence, about 3 miles (5 kilometers) west of the summit of Kearsarge Pass . . . . . PALMER, FISHER, NELSON.

Lancaster, Los Angeles County, Calif. Altitude 2,350 feet (716 meters). H, 8.

A station on the Southern Pacific Railroad in the Mohave Desert, 25 miles (40 kilometers) south of Mohave. . . . . STEPHENS.

Langley Meadow, Tulare County, Calif. Altitude 11,625 feet † (3,542 meters).

A small meadow containing a lake immediately west of and under the peak of Mount Whitney. Langley Creek, which rises in this meadow, is one of the three main streams which flow into the North Fork of Kern River from the east, above Whitney Creek. Named in honor of Prof. S. P. Langley, Secretary of the Smithsonian Institution, who established his Mountain Camp in this meadow while making observations on solar heat on Mount Whitney in the summer of 1881. . . . . PALMER, DUTCHER.

La Panza, San Obispo County, Calif. G, 4.

A post-office near the San Juan River, about 25 miles (40 kilometers) northeast of San Luis Obispo . . . . . NELSON.

Las Vegas Ranch, Lincoln County, Nev. (See Vegas Valley).

Leach Point Valley, San Bernardino County, Calif. F, 11.

A valley in the Mohave Desert north of the Granite Mountains.

Leach Point Spring on the north slope of the Granite Mountains and south side of the valley, is about 25 miles (40 kilometers) northeast of Pilot Knob, on the so-called Leach Point road from Pilot Knob to Saratoga Springs in Death Valley. Altitude about 3,500* feet (1,066 meters) . . . . . MERRIAM, BAILEY.

Lerdo, Kern County, Calif. Altitude about 414 feet (126 meters). G, 6.

A station on the Southern Pacific Railroad 12 miles (19 kilometers) northwest of Bakersfield . . . . . NELSON.

† Langley: Researches on Solar Heat, 1884, p. 194.

Lewis Lake, Inyo County, Calif. Altitude about 9,000* feet (2,743 meters).

A small lake on the west fork and near the head of Bishop Creek......STEPHENS.

Liebre Ranch, Los Angeles County, Calif.

A ranch at the north base of the Sierra Liebre, about 20 miles (32 kilometers) northwest of Elizabeth Lake..................................MERRIAM, PALMER.

Little Lake or **Little Owens Lake**, Inyo County, Calif. Altitude about 3,100* feet (944 meters). F, 9.

A small lake about 25 miles (40 kilometers) south of Owens Lake, on the road from Mohave to Keeler ....MERRIAM, PALMER, FISHER, BAILEY, STEPHENS.

Lone Pine, Inyo County, Calif. Altitude [of station] 3,638 feet (1,115 meters. D, 8.

A town on the west side of Owens Valley, 4 miles (6 kilometers) north of Owens Lake. The railroad station is on the east side of the valley.

MERRIAM, PALMER, BAILEY, FISHER, NELSON, STEPHENS.

Lone Willow Spring, San Bernardino County, Calif. F, 10.

A spring on the east slope of the Slate Range, opposite Browns Peak. The spring is in the hills some distance above the wagon road and is almost the only good water on the road between Pilot Knob and Mesquite Wells in Death Valley.

MERRIAM, BAILEY, FISHER, NELSON, PALMER.

Lookout or **Lookout Hill**, Inyo County, Calif. Alt. about 4,000* feet (1,219 meters).

A mining camp on the east slope of the Argus Mountains near the north end of the range, about 10 miles (16 kilometers) east of Darwin............FISHER, BAILEY.

Los Olivos, Santa Barbara County, Calif. H, 4.

A town on the road from San Luis Obispo to Santa Barbara, north of the Santa Ynez Mission..MERRIAM, NELSON.

Mammoth Pass, California. Altitude about 9,500* feet (2,900 meters).

A pass in the Sierra Nevada from the head of Owens River to the head of the San Joaquin...NELSON, STEPHENS.

Maturango Peak, Inyo County, Calif. Altitude 8,844 feet (2,695 meters). E, 10.

The highest peak of the Argus Mountains, about 13 miles (21 kilometers) southeast of the town of Darwin..PALMER.

Maturango Spring, Inyo County, Calif. Altitude about 6,000 feet (1,829 meters).

A small spring on the western slope of the Argus Mountains, 2 or 3 miles (3 or 5 kilometers) south of Maturango Peak, and about 15 miles (24 kilometers) southeast of the town of Darwin. Collections were made at the spring and also near the summit of the Argus Range, about 1,300 feet (396 meters) above.

BAILEY, FISHER, NELSON, PALMER.

McGill Peak, California. (See Mount Piños).

Meadow Creek Valley, Lincoln County, Nev. B, 15–16.

A valley east of the Highland Range, in which is situated the town of Panaca, about 10 miles (16 kilometers) south of Pioche. The name is given on some maps as Meadow Valley ....MERRIAM, BAILEY.

Menache Meadows, California.

In the High Sierra north or northwest of Olancha Peak ....STEPHENS.

Merced River, California. B–C, 3–6.

Rises near Mount Lyell and Mount Dana and drains the west slope of the Sierra, between the basins of the Tuolumne and the San Joaquin rivers............NELSON.

Mesquite Well, Death Valley, California. Altitude —351* feet (107 meters) E, 11.

A well on the west side of the valley, about 6 miles (10 kilometers) south of Bennet Wells ....MERRIAM, BAILEY, FISHER, PALMER.

Mesquite Valley, Inyo County, Calif. D, 10-11.

The name given to the northwest arm of Death Valley, 60 or 70 miles (95 or 110 kilometers) in length, which heads under Mount Magruder. The valley lies between the Grapevine Mountains on the east and the northern part of the Panamint Range on the west.............................MERRIAM, BAILEY, STEPHENS, NELSON.

Mill Creek, Inyo County, Calif.

A small stream at the extreme northwest end of Panamint Valley........NELSON.

Mineral King, Tulare County, Calif. Altitude about 9,000* feet (2,740 meters). E, 7.

A summer resort and mining camp near the head of the East Fork of the Kaweah River, north of Farewell Gap.................PALMER, BAILEY, FISHER, NELSON.

Mohave,† Kern County, Calif. Altitude, 2,751 feet (838 meters). G, 8.

A railroad station in the west end of the Mohave Desert, at the junction of the Atlantic and Pacific with the Southern Pacific Railroad.

MERRIAM, PALMER, STEPHENS.

Mohave † River, San Bernardino County, Calif. G-I, 10-12.

The largest stream in the Mohave Desert, usually dry throughout the greater part of its course; it rises on the north slope of the San Bernardino Mountains, east of Cajon Pass, and flows north and then east into a sink known as 'Soda Lake' or the 'Sink of the Mohave.' The river was named by Fremont in 1844, who spelled the word *Mohahve*.

Monterey, Calif. D, 1.

A town on the bay of Monterey. Collections were made between Cypress Point and Pacific Grove....................................MERRIAM, BAILEY.

Mormon Mountains, Lincoln County, Nev. C-D, 16.

A range in the eastern part of the State near the Utah line.

Moran's, Mono County, Calif.

A ranch near the head of Owens Valley, about 6 miles (10 kilometers) east of Benton...STEPHENS.

Morro, San Luis Obispo County, Calif. G, 3.

A town on the coast about 10 miles (16 kilometers) northwest of San Luis Obispo.

NELSON.

Mountain Meadows, Washington County, Utah. B-C, 17.

A valley in the southwestern part of the Territory northwest of Pine Valley Mountain. The scene of the Mountain Meadow massacre.......MERRIAM, BAILEY.

Mountain Springs, Lincoln County, Nev. Altitude, 5,501 feet (1,677 meters). E, 14.

Springs near the summit of the pass over the Charleston Mountains on the road from Pahrump to Vegas Valley, about 6 or 8 miles (10 or 13 kilometers) north-northwest of Olcott Peak.................................MERRIAM, BAILEY, NELSON.

Mount Corcoran, California. Altitude, 14,093 feet (4,295 meters). E, 8.

The 'Old Mount Whitney;' renamed by Albert Bierstadt, the artist, in honor of W. W. Corcoran, of Washington, D. C., the first name having been transferred to a higher peak. (See Geog. Rept. Wheeler Survey, I, 1889, p. 99.)

Mount LeConte, Inyo County, Calif. Altitude, 6,580 feet (2,005 meters). E, 11.

This is the most prominent peak in the Funeral Mountains, as seen from Bennett Wells in Death Valley. It is the highest point in the range and is nearly due east of Telescope Peak. It was named in honor of Prof. Joseph LeConte, of the University of California, by James J. McGillivray,‡ of New York, who visited Death Valley in 1883-4.

† The spelling is that adopted by the U. S. Board on Geographic Names.

‡ *See article entitled*: 'In the Valley of Death,' in New York Times, May (?), 1891.

Mount Lyell, California. Altitude, 13,042 feet (3,975 meters). B, 6.

A high peak in the Sierra Nevada east of the Yosemite Valley and near the headwaters of the Merced River.

Mount Magruder, Esmeralda County, Nev. Altitude about 9,500* feet (2,900 meters). C, 9.

An important mountain standing at the extreme head of the northwestern arm of Death Valley and at the southern end of the Red or Silver Peak Mountains. The Mount Magruder plateau connects the Grapevine, Panamint and Silver Peak ranges. MERRIAM, BAILEY.

Mount Perry, Inyo County, Calif. E, 11.

The highest peak in the northern part of the Funeral Mountains. It is named after Mr. J. W. S. Perry, Superintendent of the Pacific Coast Borax Company, at Daggett, to whom the expedition is indebted for many favors and for much valuable information. Mount Perry has an altitude of about 5,500* feet (1,676 meters), its summit being about 5,700 feet (by aneroid) above Greenland ranch in Death Valley.† .... PALMER.

Mount Piños. Ventura County, Calif. Altitude, 9,214 feet (2,808 meters). H, 6.

The culminating peak of the southern Coast Ranges standing near the northern boundary of the county and at the headwaters of the Cuyama River. Mount Piños, also known as McGill Peak, may be considered the center from which diverge the various ridges of the Coast Range in this region .... NELSON.

Mount Silliman, Tulare County, Calif. Altitude, 11,623 feet (3,543 meters). D, 7.

A high peak in the southern Sierra Nevada situated in the northeast corner of the Sequoia National Park .... PALMER.

Mount Smith. Inyo County, Calif. Altitude, 6,300 feet (1,920 meters). F, 11.

The highest peak at the southern end of the Funeral Mountains and opposite the entrance of Death Valley at Windy Gap. It is named after Mr. F. M. Smith, of San Francisco, President of the Pacific Coast Borax Company, who aided the expedition in Death Valley in every possible way.

Mount Whitney. California. Altitude, 14,522 feet (4,426 meters). D, 8.

The highest point in the United States, first called Fisherman Peak, but afterward renamed by Clarence King in honor of Prof. J. D. Whitney, Director of the Geological Survey of California. The peak was first ascended August 18, 1873,‡ and the records of the fourth party who ascended it (July 7, 1875), were still in the monument on the summit when Mr. Dutcher and the writer climbed the peak September 10, 1891. The altitude adopted is that determined by Prof. S. P. Langley, and is based on a series of barometric observations made simultaneously on the peak and at Lone Pine. The elevation given by Whitney is 14,898 feet (4,541 meters) and that adopted by the Wheeler Survey 14,470 feet (4,410 meters) .... PALMER, DUTCHER.

Mud Spring.

(1) Lincoln County, Nev. [C, 13.] Altitude about 5,600* feet (1,705 meters). A spring in the north end of the Desert Mountains, about 30 miles (48 kilometers) west of Pahranagat Lake .... MERRIAM, BAILEY.

(2) Mohave County, Ariz. [G, 16.] A spring at the north end of the Sacramento Valley, about 35 miles (56 kilometers) northeast of The Needles, Calif. Collections were made in 1889 by .... BAILEY.

† There is a peak immediately north of Mount Perry, which is almost as prominent from Death Valley but which is 300 feet (90 meters) lower.

‡ See Geog. Rept. Wheeler Survey, I, 1889, p. 100.

Muddy Valley, Lincoln County, Nev. D-E, 15-16.

A valley northeast of the Muddy Mountains. The stream of the same name flowing through the valley empties into the Virgin River.............. MERRIAM, BAILEY.

Mulkey Meadows, Inyo County, Calif.

A small meadow on the east slope of the Sierra, about 7 miles (11 kilometers) southeast of Big Cottonwood Meadows and about 12 or 15 miles (19-24 kilometers) south of Mount Whitney ....DUTCHER, KOCH.

Nelson Range, Inyo County, Calif. D, 9.

A low east-and-west range connecting the Cerro Gordo with the Panamint Mountains and separating Saline Valley from the head of Panamint Valley. Named after Mr. E. W. Nelson, who explored the range and the adjoining valleys.......NELSON.

Nordhoff, Ventura County, Calif. Altitude, 819 feet (249 meters). I, 6.

A town in the Ojai Valley, northeast of Ventura.........................NELSON.

Oasis Valley, Nye County, Nev. C-D, 11.

A narrow valley in the southern part of the Ralston Desert southeast of Sarcobatus Flat. It contains the head of Amargosa Creek ....MERRIAM, BAILEY, STEPHENS.

Olancha, Inyo County, Calif. Altitude, 3,708 feet (1,130 meters). E, 9.

A ranch and post-office 1 mile (0.6 kilometers) south of Owens Lake.

MERRIAM, PALMER, BAILEY, FISHER, STEPHENS.

Olancha Peak, California. Altitude, 12,250 feet (3,734 meters). E, 8.

One of the highest peaks in the southern Sierra Nevada, about 25 miles (40 kilometers) southeast of Mount Whitney....................................STEPHENS.

Onion Valley, Inyo County, Calif. Altitude, about 9,000 or 10,000 feet* (2,740 or 3,050 meters).

A meadow or small valley on the east slope of the Sierra at the junction of the three forks of Independence Creek....................................STEPHENS.

Overton, Lincoln County, Nev. Altitude, 1,360 feet (414 meters). E, 16.

An abandoned Mormon town in the valley of the Muddy, northwest of St. Thomas and 4 miles (6 kilometers) southeast of St. Joe..................MERRIAM, BAILEY.

Owens Lake, California. Altitude, 3,567 feet (1,087 meters). D-E, 9.

A shallow alkaline lake 15 miles (24 kilometers) long, 9 miles (14 kilometers) wide, and about 50 feet (15 meters) deep. It is situated at the east base of the Sierra Nevada, southeast of Mount Whitney. Named by Fremont, in honor of Richard Owens, one of the members of Fremont's third expedition.

MERRIAM, PALMER, FISHER, NELSON, BAILEY, STEPHENS.

Owens River, California. B-D, 7-8.

The largest river on the east side of the southern Sierra Nevada. It rises near Mount Lyell and flows south through a valley of the same name into Owens Lake.

Owl Holes, San Bernardino County, Calif. Altitude 1,790* feet (545 meters). F, 11.

Holes containing hot water on the Leach Point road from Pilot Knob to Death Valley, situated on the south side of Owls Head Peak and about 13 miles (21 kilometers) west-southwest of Saratoga Springs ....MERRIAM, BAILEY.

Pahranagat Lake, Lincoln County, Nev. Altitude, 3,400 feet (1,036 meters). C, 14.

A small lake in the south end of the valley of the same name, lying east of the Pahranagat Mountains and about 60 miles (96 kilometers) southwest of the mining camp of Pioche...MERRIAM, BAILEY.

Pahranagat Range, Lincoln County, Nev. C, 14.

A desert range separating Timpahute Valley on the west from Pahranagat Valley on the east .... MERRIAM, BAILEY.

Pahroc Spring, Lincoln County, Nev. Altitude 5,700* feet (1,737 meters), (approximate). B, 15.

A spring near the southern end of the Pahroc Range on the east side of the plain of the same name and about 30 miles (48 kilometers) southwest of Pioche.

MERRIAM, BAILEY.

Pahrump Valley. E–F, 12–13.

A valley lying on the boundary line between California and Nevada immediately west of the Charleston Mountains and north of Kingston Peak. Collections were made by Fisher, Nelson, and Palmer in the northwest arm near the boundary line; by Nelson and Palmer at Winters' Ranch in the north central part of the valley, and by Merriam and Bailey at Yount's Ranch, 6 or 7 miles (10 or 11 kilometers) southeast of Winters' Ranch.

Palm Springs, San Diego County, Calif.

The springs formerly known as Agua Caliente in Palm Valley on the Colorado Desert about 15 miles (24 kilometers) southeast of the San Gorgonio Pass and 6 or 7 miles (10 or 11 kilometers) south of the station of Seven Palms on the Southern Pacific Railroad .... STEPHENS.

Pampa, Kern County, Calif. Altitude, 871 feet (265 meters).

A station on the Southern Pacific railroad 15 miles (24 kilometers) southeast of Bakersfield .... BAILEY, FISHER.

Panaca, Lincoln County, Nev. Altitude, 4,770 (?) feet (1,550 meters). B, 16.

A Mormon town in Meadow Creek Valley, about 10 miles (16 kilometers) south of Pioche .... MERRIAM, BAILEY.

Panamint, Inyo County, Calif. Altitude, 6,605 feet (2,013 meters). E, 10.

A deserted mining camp on the west slope of the Panamint Mountains, about 4 or 5 miles (6 or 8 kilometers) south of Telescope Peak....... BAILEY, FISHER, NELSON.

Panamint Mountains, Inyo County, Calif. C–F, 9–10.

A high range lying immediately west of Death Valley, which it separates from Panamint Valley. The highest point, Telescope Peak, has an altitude of 10,938 feet (3,333 meters) .... MERRIAM, BAILEY, FISHER, NELSON, STEPHENS.

Panamint Valley, Inyo County, Calif. E–F, 10.

A large valley lying between the Panamint Range on the east and the Argus Mountains on the west. The bottom of the valley on the east side of the alkali flat has an altitude of about 1,300 feet (395 meters).

MERRIAM, BAILEY, FISHER, NELSON, STEPHENS.

Paradise Valley, San Bernardino County, Calif. G, 10.

A valley in the Mohave Desert southeast of Pilot Knob. The dry lake in the bottom of the valley has an altitude of about 3,000* feet (915 meters).

MERRIAM, PALMER, FISHER.

Perognathus Flat, Inyo County, Calif. Altitude, about 5,200* feet (1,585 meters).

A basin on the west slope of the Panamint Mountains at the head of Emigrant Cañon. Named on account of the unusual abundance of pocket mice of the genus *Perognathus* .... MERRIAM, BAILEY, STEPHENS.

Peru Creek, California. H–I, 6–7.

A stream flowing south from Alamo Peak (near the line between Ventura and Los Angeles counties) *into the Santa Clara River* .... MERRIAM, PALMER.

Pigeon Spring, Esmeralda County, Nev. Altitude, about 6,700* feet (2,040 meters). C, 9.

A spring on the northwest slope of Mount Magruder near the California boundary. MERRIAM, BAILEY.

Pilot Knob or Granite Mountain, San Bernardino County, Calif. Altitude, 5,525 feet (1,683 meters). G, 10.

A high butte or peak forming one of the most conspicuous landmarks in the Mohave Desert. It is at the west end of the Granite Mountains and about 75 miles (120 kilometers) southeast of the lower end of Owens Lake and about 35 miles (56 kilometers) northwest of Daggett and Barstow. On a clear day it can be distinctly seen from the summit of Mount Whitney and Telescope Peak. (See also Granite Mountains.)

Pine City.

(1) Mariposa County, Calif. A settlement, formerly a post-office, on the west slope of the Sierra, about 4 miles (6 kilometers) south of Wawona, near the southern boundary of the county.

(2) Mono County, Calif. A deserted mining camp near the head of Owens River and a few hundred feet below the summit of Mammoth Pass.... NELSON, STEPHENS.

Pioche, county seat of Lincoln County, Nev. Altitude, 6,220 feet (1,895 meters). B, 16.

Formerly an important mining camp; in the northern part of the county.

Poso, Kern County. Calif. F, 6.

A station on the Southern Pacific Railroad in the San Joaquin Valley, 20 miles (32 kilometers) northwest of Bakersfield.................... BAILEY, FISHER, NELSON.

Pozo, San Luis Obispo County, Calif. G, 4.

A post-office about 15 miles (24 kilometers) east of San Luis Obispo. To be distinguished from Poso, Kern County................................... NELSON.

Quartz Spring, Lincoln County, Nev. Altitude, about 5,200* feet (1,585 meters). D, 13.

A spring at the west base of the Desert Mountains in the north arm of Indian Spring Valley... MERRIAM, BAILEY.

Queen, Esmeralda County, Nev. Altitude, 6,254 feet (1,906 meters).

A station on the Carson and Colorado Railroad 10 miles (16 kilometers) northeast of Benton, Calif. The Indian Queen mine is situated in the northern end of the White Mountains, about 9 miles (14 kilometers) from the station, and at an altitude of about 9,500* feet (2,895 meters); the mill connected with it is 5 miles (8 kilometers) from the station, at an elevation of about 7,400* feet (2,250 meters)...... STEPHENS.

Raymond Well, Kern County, Calif.

A spring in the south end of Salt Wells Valley in the Mohave Desert, about 16 miles (26 kilometers) southeast of Coyote Holes or Freeman Post-office... STEPHENS.

Rêche Cañon, San Bernardino County, Calif.

A narrow valley on the north side of the Box Spring Mountains, about 4 miles (6 kilometers) south of San Bernardino.................................. STEPHENS.

Resting Springs, Inyo County, Calif. Altitude about 1,750* feet (5,320 meters). F, 12.

The springs near the Amargosa River, about 6 miles (10 kilometers) east of the Amargosa borax works.... MERRIAM, PALMER, BAILEY, FISHER, NELSON, STEPHENS.

Rose Store or Station, Kern County, Calif. Altitude, 1,334 feet (406 meters).

An old stage station on the road from Bakersfield to Los Angeles, about 6 miles (10 kilometers) north of Old Fort Tejon, near the mouth of the Cañada de las Uvas. PALMER, NELSON.

Round Valley, Inyo County, Calif.

A small meadow in the High Sierra, 2 miles (3 kilometers) south of Big Cottonwood Meadows and about 12 miles (19 kilometers) south of Mount Whitney.

PALMER, FISHER.

Saint George, Washington County, Utah. Altitude, 2,880 feet (877 meters). C, 17.

A flourishing Mormon town near the junction of the Santa Clara and Virgin rivers in the extreme southwestern corner of Utah ....MERRIAM, BAILEY.

St. Joe, Lincoln County, Nev. Altitude, 1,650* feet or 503 meters (1,490 feet or 454 meters, Powell). D, 16.

A small Mormon settlement in the valley of the Muddy about 15 miles (24 kilometers) northwest of St. Thomas ....MERRIAM, BAILEY.

St. Thomas, Lincoln County, Nev. Altitude, 1,450* feet or 442 meters (1,180 feet or 360 meters, Powell). E, 16.

A small Mormon settlement near the Virgin River, about 30 miles (48 kilometers) northeast of the great bend of the Colorado River ....MERRIAM, BAILEY.

Saline Valley, Inyo County, Calif. D, 9.

A valley lying northeast of Owens Lake, between the Inyo Mountains and the northern extension of the Panamint Mountains..............................NELSON.

Salt Wells, Death Valley, California.

(1) A spring of strongly alkaline water unfit for use, at the south end of Death Valley near the entrance from Windy Gap and about 15 miles (24 kilometers) south of Bennett Wells. Observations made by the U. S. Geological Survey show the altitude of this spring to be 307 feet (93 meters) below sea level.

MERRIAM, PALMER, FISHER, BAILEY, NELSON.

(2) A spring in Mesquite Valley (the northwestern arm of Death Valley) opposite the mouth of Cottonwood Cañon. Altitude, about 150? feet or 45 meters (Wheeler). D, 10..STEPHENS, NELSON.

Salt Wells Valley, California. F, 9.

The name applied to that portion of the Mohave Desert lying south of the Coso Mountains and west of the southern end of the Argus Mountains.

MERRIAM, PALMER, BAILEY, FISHER, STEPHENS.

San Bernardino Range, California (see also Sierra Madre).

A high range of mountains between the Mohave Desert and the San Bernardino Valley. The highest point, San Bernardino Peak, reaches an altitude of 11,600 feet (3,535 meters). The name is frequently restricted to that part of the range east of the Cajon Pass...STEPHENS.

San Emigdio, Kern County, Calif. H, 6.

A sheep ranch in the cañon of the same name, about 10 or 15 miles (16 or 24 kilometers) north of Mount Piños...NELSON.

San Francisquito Pass, Los Angeles County, Calif. Altitude, 3,718 feet (1,133 meters). H-I, 7-8.

A pass in the Sierra Liebre leading north from the Santa Clara Valley to Elizabeth Lake and the Mohave Desert ....PALMER.

San Gorgonio Pass, California. Altitude, about 2,800 feet (850 meters).

A pass leading from the San Bernardino Valley to the Colorado Desert, through which runs the Southern Pacific Railroad. It is on the boundary line between San Diego and San Bernardino counties..................................STEPHENS.

San Joaquin River, California. B—C, 6.

This river rises near the summit of the Sierra Nevada, flows southwest to the San Joaquin Valley, and turning northward empties into San Francisco Bay. The stream referred to in the report is the head of the main river..............NELSON.

San Luis Obispo, county seat of San Luis Obispo County, Calif. G, 3.
MERRIAM, NELSON.

San Simeon, San Luis Obispo County, Calif. F, 2.

A port on bay of same name about 40 miles (65 kilometers) northwest of San Luis Obispo .... NELSON.

Santa Clara Valley.

(1) Washington County, Utah. [C, 17.] The valley of the Santa Clara River (a branch of the Virgin River) in the lower part of which the town of St. George is situated .... MERRIAM, BAILEY.

(2) Ventura County, California. [H-I. 6-8.] The valley of the Santa Clara River, a stream rising in the Soledad Pass and flowing westward into the Santa Barbara Channel.

(3) Santa Clara County, California. A large valley at the southern end of San Francisco Bay in which are the towns of San Jose and Santa Clara.

Santa Margarita, San Luis Obispo County, Calif. Altitude, 996 feet (304 meters). G, 3.

A post-office and station on the coast division of the Southern Pacific Railroad about 10 miles (16 kilometers) northeast of San Luis Obispo .... NELSON.

Santa Maria, Santa Barbara County, Calif. H, 4.

A town on the road from San Luis Obispo to Santa Barbara, about 25 or 30 miles (40-50 kilometers) southeast of San Luis Obispo .... NELSON.

Santa Paula, Ventura County, Calif. Altitude 286 feet (87 meters).

A station on the Southern Pacific Railroad, 44 miles (70 kilometers) east of Santa Barbara .... NELSON.

Santa Yñez Mission, Santa Barbara County, Calif. H, 4.

An old Spanish mission on the road from Santa Barbara to San Luis Obispo, 25 or 30 miles (40 or 48 kilometers) northwest of Santa Barbara .... NELSON.

Saratoga Springs, Inyo County, Calif. Altitude 352* feet (107 meters). F, 12.

Warm springs in the extreme southeast end of Death Valley, near the bend of the Amargosa River, on the road from Daggett to Resting Springs.
MERRIAM, BAILEY, PALMER, NELSON, STEPHENS.

Sarcobatus Flat, Nevada. Altitude about 4,400* feet (1,340 meters). C, 10-11.

A flat or valley between the Grapevine Mountains and the Ralston Desert, on the boundary between Nye and Esmeralda counties. Named from the greasewood (*Sarcobatus vermiculatus*) which covers the clay dunes in the lower part of the flat.
MERRIAM, BAILEY, STEPHENS.

Searles' Borax Works, California. (See Borax Flat).

Sheep Spring, Lincoln County, Nev. Altitude about 6,700* feet (2,041 meters). B, 16.

A spring on the east slope of the Juniper Mountains, about 20 miles (32 kilometers) southeast of Pioche .... MERRIAM, BAILEY.

Shepherd Cañon, Inyo County, Calif. E, 10.

A pass in the Argus Mountains on the road between Coso and Panamint valleys, about 6 or 8 miles (10 or 13 kilometers) south of Maturango Peak.
BAILEY, FISHER, NELSON.

Shoal Creek, Utah. B, 17.

A small stream on the east slope of the southern part of the Juniper Mountains, sinking before reaching the Escalante Desert; about 30 or 35 miles (48 or 55 kilometers) northwest of St. George .... MERRIAM, BAILEY.

Sierra Liebre, Los Angeles County, Calif. H, 7–8.

The name applied to the western part of the Sierra Madre, between Frazier Mountain and the San Francisquito Pass, and lying immediately south of Antelope Valley. The portion of the range between the San Francisquito and Soledad passes is known as the Sierra Pelona .... MERRIAM, PALMER.

Sierra Madre, California. I, 8–10.

A high range of mountains, also known as the San Bernardino Range, forming the southern boundary of the Mohave Desert, and separating it from the San Gabriel and San Bernardino valleys. The name Sierra Madre is commonly restricted to that part of the range west of Cajon Pass. The highest peak is Mount San Antonio, also known as Baldy (altitude 9,931 feet, or 3,026 meters).

Slate Range, California. F, 10.

A spur of the Argus Range, separating Panamint Valley from Searles' Borax Flat. The highest peak west of Lone Willow Spring has an altitude of 5,598 feet (1,706 meters).

Soda Springs, Tulare County, Calif. Altitude about 7,000 * feet (2,134 meters).

A camping resort on the North Fork of Kern River on the 'Hockett Trail,' at the mouth of Whitney Creek. Locally known as 'Kern River Lakes.'

PALMER, BAILEY, FISHER, NELSON.

Stewart Wells, Inyo County, California.

A spring in the extreme northwestern part of Pahrump Valley (near the California and Nevada line), on the road from Resting Springs to Ash Meadows.

PALMER, FISHER, NELSON, STEPHENS.

Stoddard Wells, San Bernardino County, Calif.

A spring in the Mohave Desert, on the direct road from Victor to Daggett, about 20 miles (32 kilometers) southwest of the latter point............. PALMER, FISHER.

Surprise Cañon, Inyo County, Calif.

A cañon on the west slope of the Panamint Mountains, a little south of Telescope Peak. The abandoned mining camp of Panamint is situated in the cañon, about 6 miles (10 kilometers) above its mouth, at an altitude of 6,605 feet (2,013 meters).

BAILEY, FISHER, NELSON.

Table Mountain, Nye County, Nev. C, 12.

A high mountain or mesa in the southern part of the Ralston Desert some distance north of Ash Meadows.. STEPHENS.

Tehachapi, Kern County, Calif. Altitude 4,025 feet (1,226 meters). G, 8.

A town and station on the Southern Pacific Railroad, situated in a valley of the same name, at the summit of Tehachapi Pass.................... MERRIAM, PALMER.

Tehachapi Mountains, California. (See Tejon Mountains).

Tehachapi Pass, Kern County, Calif. Altitude 3,832 feet (1,168 meters). G, 8.

A pass in the Tehachapi Mountains, through which the Southern Pacific Railroad runs, just east of the peak of the same name and about 45 miles (72 kilometers) southwest of Walker Pass.................................. MERRIAM, PALMER.

Tejon Mountains, Kern County, Calif. G–H, 7–8.

A range known also as the Tehachapi Mountains, running southwest and northeast, separating the San Joaquin Valley from the Mohave Desert and connecting the southern Sierra Nevada with the southern Coast Ranges. The highest points are Tehachapi Peak (altitude 8,056 feet, or 2,455 meters), Double Peak (8,263 feet, or 2,518 meters), and Mount Piños (altitude 9,214 feet, or 2,808 meters). The four principal passes are Walker, Tehachapi, Tejon, and the Cañada de las Uvas.

Tejon Pass, Kern County, Calif. H, 7.

A pass in the Tejon Mountains, southwest of Tehachapi Pass and the mountain of the same name. Formerly used as a wagon pass from the head of the San Joaquin Valley to the Mohave Desert .... PALMER.

Tejon Ranch, Kern County, Calif. Altitude about 1,450 feet (440 meters).

Three miles west of the mouth of Tejon Pass, at the extreme southeast end of the San Joaquin Valley and about 10 miles (16 kilometers) northeast of the mouth of the Cañada de las Uvas .... PALMER.

Telescope Peak, Inyo County, Calif. Altitude 10,938 feet (3,333 meters). E, 10.

The highest peak in the Panamint Mountains, west of Bennett Wells in Death Valley .... FISHER, BAILEY.

Temploa Mountains, California.

A low range of mountains between the San Joaquin Valley and the Carrizo Plains. On the boundary between San Luis Obispo and Kern counties .... NELSON.

Thorpe Mill, Esmeralda County, Nev.

An abandoned quartz mill at the east foot of the Grapevine Mountains and on the west side of Sarcobatus Flat, about 10 miles (16 kilometers) southeast of Gold Mountain .... MERRIAM, BAILEY, STEPHENS.

Timpahute Valley, Nevada. B–C, 13–14.

A desert valley lying near the boundary line between Nye and Lincoln counties, between the Timpahute Range on the west and Pahranagat Range on the east. MERRIAM, BAILEY.

Three Rivers, Tulare County, Calif. E, 7.

A post-office about 25 miles (40 kilometers) northeast of Visalia, in the foothills of the Sierra near the junction of the North, East, and South forks of the Kaweah River .... PALMER, BAILEY, FISHER, NELSON.

Trout Meadows, Tulare County, Calif. Altitude about 6,000' feet (1,829 meters).

The meadows on the trail from Mineral King to Soda Springs, just west of the divide between Little Kern River and the North Fork.

PALMER, BAILEY, FISHER, NELSON.

Tulare, Tulare County, Calif. Altitude 282 feet (85 meters). E, 6.

A town on the Southern Pacific Railroad, 11 miles (18 kilometers) southwest of Visalia .... PALMER, BAILEY, FISHER, NELSON.

Tule Spring, Esmeralda County, Nev. C, 9.

A spring in Tule Cañon, on the south slope of Mount Magruder.

MERRIAM, BAILEY.

Twelve Mile Spring, Inyo County, Calif.

A spring on the road from Resting Springs to Pahrump Valley, 12 miles (19 kilometers) north of Resting Springs .... PALMER, FISHER, NELSON, STEPHENS.

Twin Oaks, San Diego County, Calif.

A post-office in Merriam Valley, about 15 miles (24 kilometers) southeast of the old mission of San Luis Rey and 5 miles west of Escondido .... MERRIAM, KOCH.

Vegas Valley, Lincoln County, Nev. E, 14.

A large valley in the southern part of the State, directly east of the Charleston Mountains. Vegas Ranch, on the east side of the valley, has an altitude of 2,071 feet (631 meters) .... MERRIAM, BAILEY, NELSON.

Vegas Wash, Lincoln County, Nev. E, 15.

The wash running from Vegas Valley to the Colorado River near the Great Bend, and 4 miles south of the site of Callville .... MERRIAM, BAILEY, NELSON.

Victor, San Bernardino County, Calif. Altitude, 2,713 feet or 827 meters (S. C. Ry.). I, 10.

A station on the Southern California Railway, on the Mohave River, a few miles north of Cajon Pass and 45 miles (72 kilometers) north of San Bernardino.
MERRIAM, PALMER, FISHER.

Virgin River, Utah, Arizona, and Nevada. C–E, 16–18.

A large stream which rises in southwestern Utah and empties into the Colorado River about 15 miles (24 kilometers) east of the Great Bend. The Virgin Valley referred to in the report is the valley along the lower part of the river, in the State of Nevada .... MERRIAM, BAILEY.

Visalia, the county seat of Tulare County, Calif. Altitude, 348 feet (105 meters). E, 6........ PALMER, BAILEY, FISHER, NELSON.

Walker Basin, Kern County, Calif. G, 7–8.

A valley about 8 or 10 miles (13 or 16 kilometers) south of Havilah, on the road between that point and Caliente. Mossman's Ranch in the south end of the valley has an altitude of 3,157 feet (961 meters)...... MERRIAM, PALMER, BAILEY, FISHER.

Walker Pass, Kern County, Calif. Altitude 5,100 * feet or 1,555 meters (5,322 feet or 1,622 meters, Wheeler). F, 8.

A wagon pass through the south end of the Sierra Nevada from the South Fork of Kern River to the Mohave Desert. Named by Fremont in honor of Joseph Walker, guide on the third Fremont expedition........ MERRIAM, PALMER, FISHER, BAILEY.

Watkins' Ranch, Nye County, Nev.

A ranch in Ash Meadows 3 or 4 miles (4 or 6 kilometers) west of King Spring, owned by George Watkins. The base camp of the expedition was located here for several weeks in March, 1891, and collections were made by
PALMER, BAILEY, FISHER, NELSON.

Waucoba Peak, Inyo County, Calif. Altitude 11,267 feet (3,434 meters).

One of the highest peaks in the Inyo Mountains, situated at the head of Saline Valley, about 25 miles (40 kilometers) northeast of the town of Independence..NELSON.

Wawona, Mariposa County, Calif.

A stage station in the western foothills of the Sierra Nevada on the Raymond and Yosemite Valley road, 36 miles or 58 kilometers (by road) north of Raymond, Fresno County........ NELSON.

White Mountains, Inyo County, Calif. B, 8.

A high range on the east side of Owens Valley, forming a northern continuation of the Inyo Mountains. The highest point, White Mountain Peak, has an altitude of 14,245 feet (4,342 meters)........ MERRIAM, BAILEY, NELSON.

Whitney Creek, Tulare County, Calif.

The largest stream entering the North Fork of Kern River from the east; it rises in Whitney Meadows 8 or 10 miles (13 or 16 kilometers) south of Mount Whitney and empties into the North Fork of Kern River near Soda Springs.

Whitney Meadows, Tulare County, Calif. Altitude 9,371 feet (2,856 meters).

Large meadows near timber-line at the head of Whitney Creek, about 10 miles (16 kilometers) south of Mount Whitney and 3 miles (5 kilometers) southwest of Big Cottonwood Meadows........ PALMER, BAILEY, FISHER, NELSON, STEPHENS, DUTCHER.

Wild Rose Spring, Inyo County, Calif. Altitude 4,060 feet (1,237 meters). E, 10.

A spring situated in a cañon of the same name on the west slope of the Panamint Mountains, about 10 miles (16 kilometers) northwest of Telescope Peak.
MERRIAM, BAILEY, FISHER, STEPHENS.

Willow Creek, Inyo County, Calif.

A small stream in the Panamint Mountains rising on the west side, near the summit of the divide in Cottonwood Cañon. It flows down a rocky cañon and sinks at the border of of Saline Valley...NELSON.

Willow Spring, Kern County, Calif. Altitude 2,573 feet (783 meters). H, 8.

A spring in the western part of the Mohave Desert about 13 miles (21 kilometers) southwest of Mohave on the road from Tehachapi to Los Angeles via the San Francisquito Pass. It should be distinguished from Lone Willow Spring, San Bernardino County, near the entrance to Panamint Valley....................MERRIAM, PALMER.

Windy Gap, Inyo County, Calif. F, 10-11.

A broad, open cañon (al [illegible] Valley), connecting the south end of Panamint Valley with De[illegible] name is sometimes restricted to the eastern end of the cañon n[illegible] Death Valley.
[illegible]M, PALMER, BAILEY, FISHER, NELSON.

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A ranch in the northeaste[illegible]rump Valley, about 4 miles (6 kilometers) from the west base of [illegible]ntains....PALMER, NELSON, BAILEY.

Wood Cañon, Calif.

A cañon on the east slop[illegible]e Mountains southeast of Grapevine Peak and near the eastern b[illegible]nia.........................NELSON.

Yosemite Valley, Mariposa County, Calif. [illegible]ltitude about 4,000 feet (1,219 meters). B, 5.

The well known valley on the Merced River celebrated for its scenery....NELSON.

Yount's Ranch, Nye County, Nev.

A ranch in Pahrump Valley, near the west base of the Charleston Mountains.
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Whitney Creek, Tulare County, Calif.

The largest stream entering the North Fork of Kern River [illegible]

Whitney Meadows, [illegible]

[illegible]

Wild [illegible]

[illegible]

Willow Creek, Inyo County, Calif.

A small stream in the Panamint Mountains rising on the west side, near the summit of the divide in Cottonwood Cañon. It flows down a rocky cañon and sinks at the border of of Saline Valley...Nelson.

Willow Spring, Kern County, Calif. Altitude 2,573 feet (783 meters). H, 8.

A spring in the western part of the Mohave Desert about 13 miles (21 kilometers) southwest of Mohave on the road from Tehachapi to Los Angeles via the San Francisquito Pass. It should be distinguished from Lone Willow Spring, San Bernardino County, near the entrance to Panamint Valley....................Merriam, Palmer.

Windy Gap, Inyo County, Calif. F, 10–11.

A broad, open cañon (also known as Long Valley), connecting the south end of Panamint Valley with Death Valley. The name is sometimes restricted to the eastern end of the cañon near the entrance to Death Valley.

Merriam, Palmer, Bailey, Fisher, Nelson.

Winters' Ranch, Nye County, Nev.

A ranch in the northeastern part of the Pahrump Valley, about 4 miles (6 kilometers) from the west base of the Charleston Mountains....Palmer, Nelson, Bailey.

Wood Cañon, Calif.

A cañon on the east slope of the Grapevine Mountains southeast of Grapevine Peak and near the eastern boundary of California..........................Nelson.

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Merriam, Bailey.

INDEX.

[**Names of new genera and species are given in heavy type.**]

Sceloporus clarkii. 2. *S. magister.* 3. *S. zosteromus.* 4. *S. orcutti.* 5. *S. boulengeri.*
6. *S. floridanus.*

PLATE I.

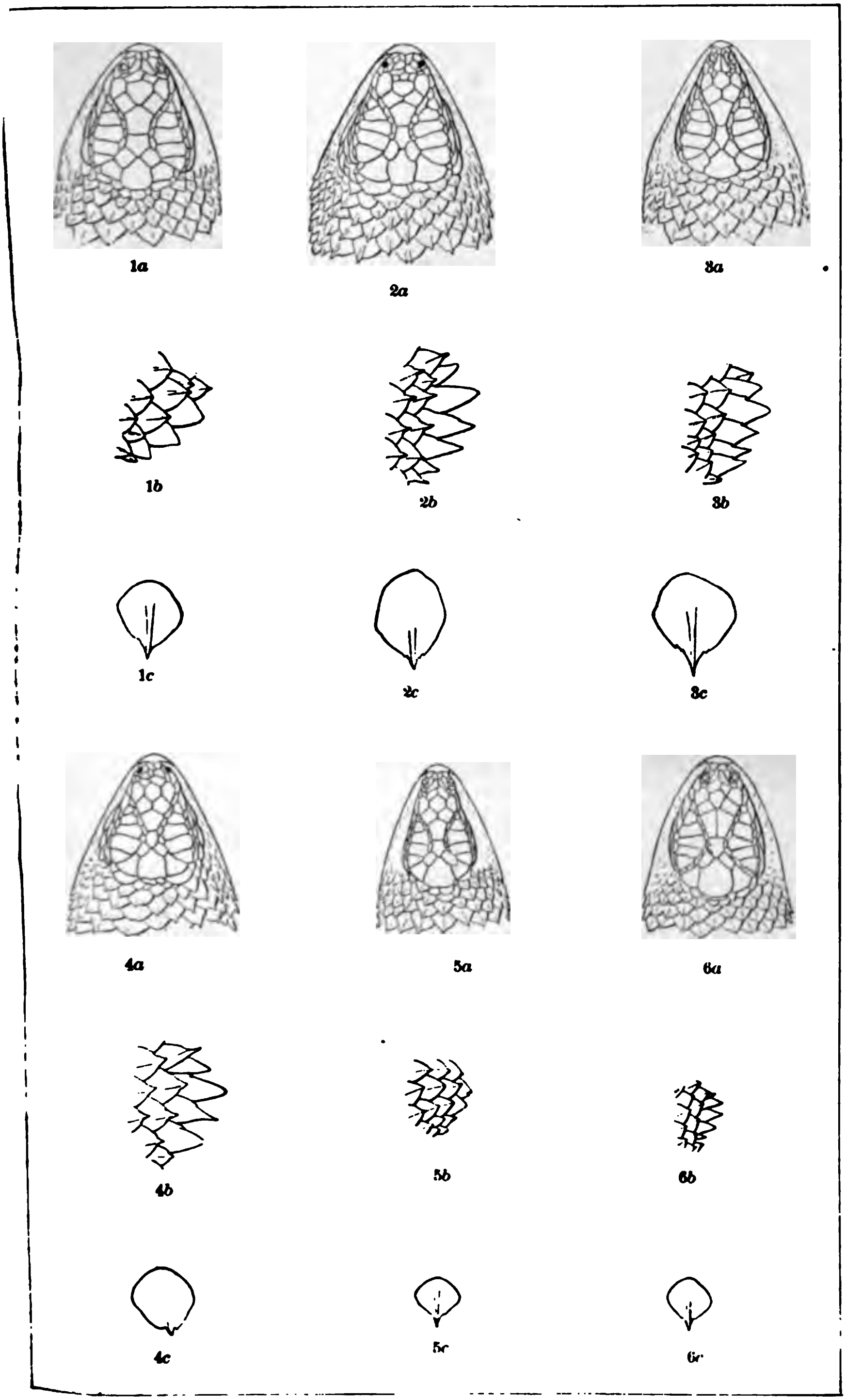
1. *Sceloporus clarkii* B. & G. *Type.* (2940)
   'Sonora.'
2. *Sceloporus magister* Hallow. (18126).
   Mohave Desert, California.
3. *Sceloporus zosteromus* Cope. *Type.* (5298).
   Cape St. Lucas, Lower California.
4. *Sceloporus orcutti* Stejn., sp. nov. *Type.* (16330).
   Milquatay Valley, San Diego County, Calif.
5. *Sceloporus boulengeri* Stejn., sp. nov. *Type.* (14079).
   Presidio, western Mexico.
6. *Sceloporus floridanus* Baird. *Type.* (2874).
   Pensacola, Fla.

On all the figures—

a represents top of head; all natural size except fig. 6, which is $1\frac{1}{4}$ t natural size.

b represents the scales bordering the left ear anteriorly; all twice nat size.

c represents one of the dorsal scales; all $2\frac{1}{2}$ times natural size.



1. Sceloporus clarkii. 2. S. magister. 3. S. zosteromus. 4. S. orcutti. 5. S. boulengeri. 6. S. floridanus.

PLATE II.

[All natural size.]

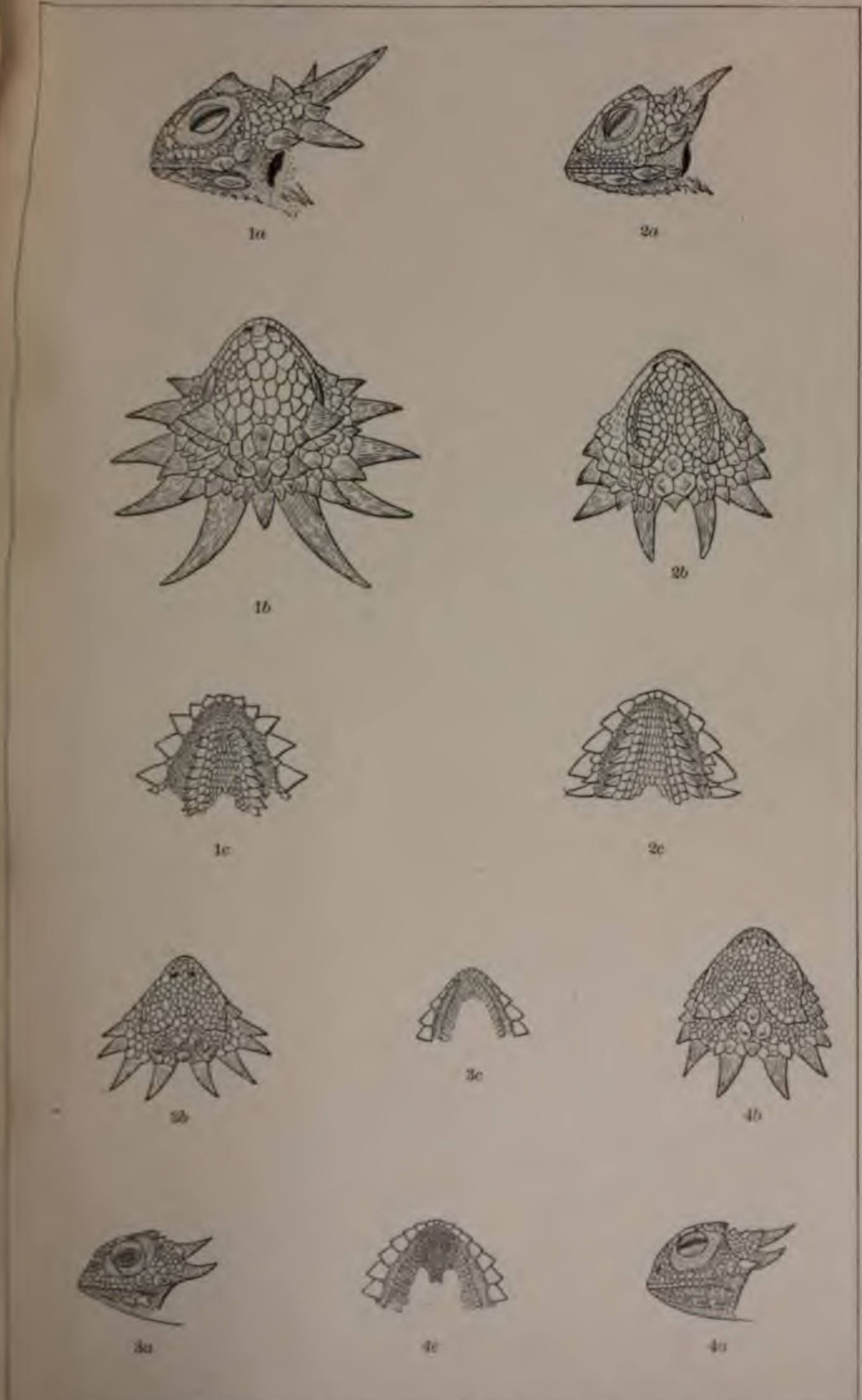
1. *Phrynosoma cornutum* Blainv. (12618).
   Cape St. Lucas, Lower California.
2. *Phrynosoma blainvillii* Gray. (18459).
   Old Fort Tejon, Calif.
3. *Phrynosoma goodei* Stejn., sp. nov. *Type.* (8567*a*).
   Coast of Sonora, Mexico.
4. *Phrynosoma platyrhinos* Girard. (18461).
   Ash Meadows, Nevada.

On all the figures—

a represents head in profile.

b represents top of head, mandibular spines excluded.

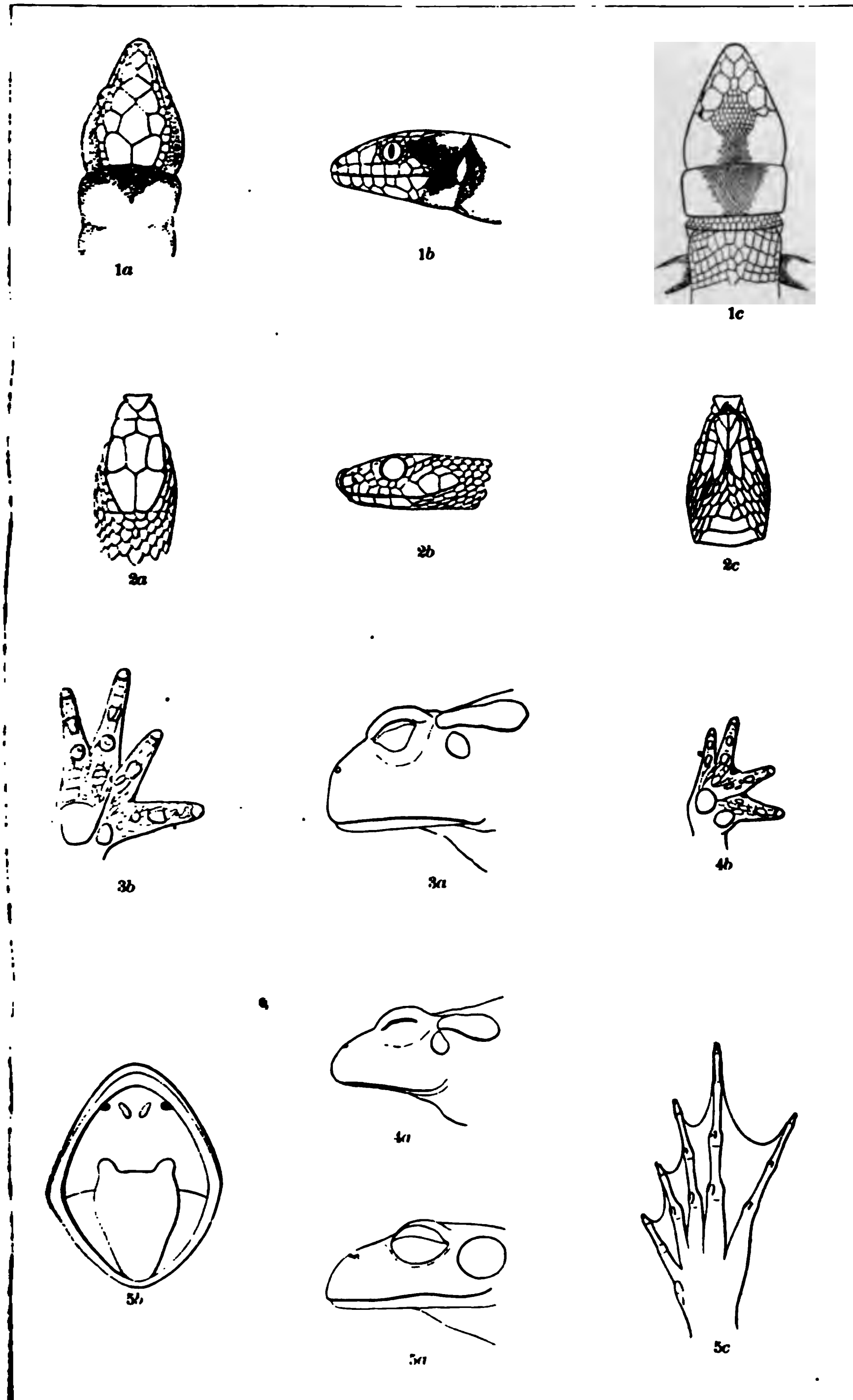
c represents mandible from below, maxillar and other cephalic spines excluded.



1. *Phrynosoma cornutum.* 2. *P. blainvillii.* 3. *P. goodei.* Type. 4. P. platyrhinos.

PLATE III.

1. *a, b, c, Xantusia vigilis* Baird. (18619.)
   Hesperia, Calif. (Twice natural size.)
2. *a, b, c, Salvadora hexalepis* (Cope). (18060.)
   Argus Range, California. (Natural size.)
3. *a, b, Bufo halophilus* B. & G. (18726.)
   Lone Pine, California. (Natural size.)
4. *a, b, Bufo boreas nelsoni* Stejn., subsp. nov. *Type.* (18742.)
   Oasis Valley, Nevada. (Natural size.)
5 *a, b, c, Rana fisheri* Stejn., sp. nov. *Type.* (18957.)
   Vegas Valley, Nevada. (Natural size.)



1. *Xantusia vigilis.* 2. *Salvadora hexalepis.* 3. **Bufo halophilus.**
4. *Bufo boreas nelsoni*, subsp. nov. 5. *Rana fisheri*, sp. nov.

THE CHUCK-WALLA (*Sauromalus ater*).

Argus Range, California.

PLATE V.

Fig. 1. *Empetrichthys merriami* Gilbert, sp. nov. *Type.*
Ash Meadows, Nevada.

Fig. 2. Pharyngeals and gill arches from the side. (4½ times natural size.)

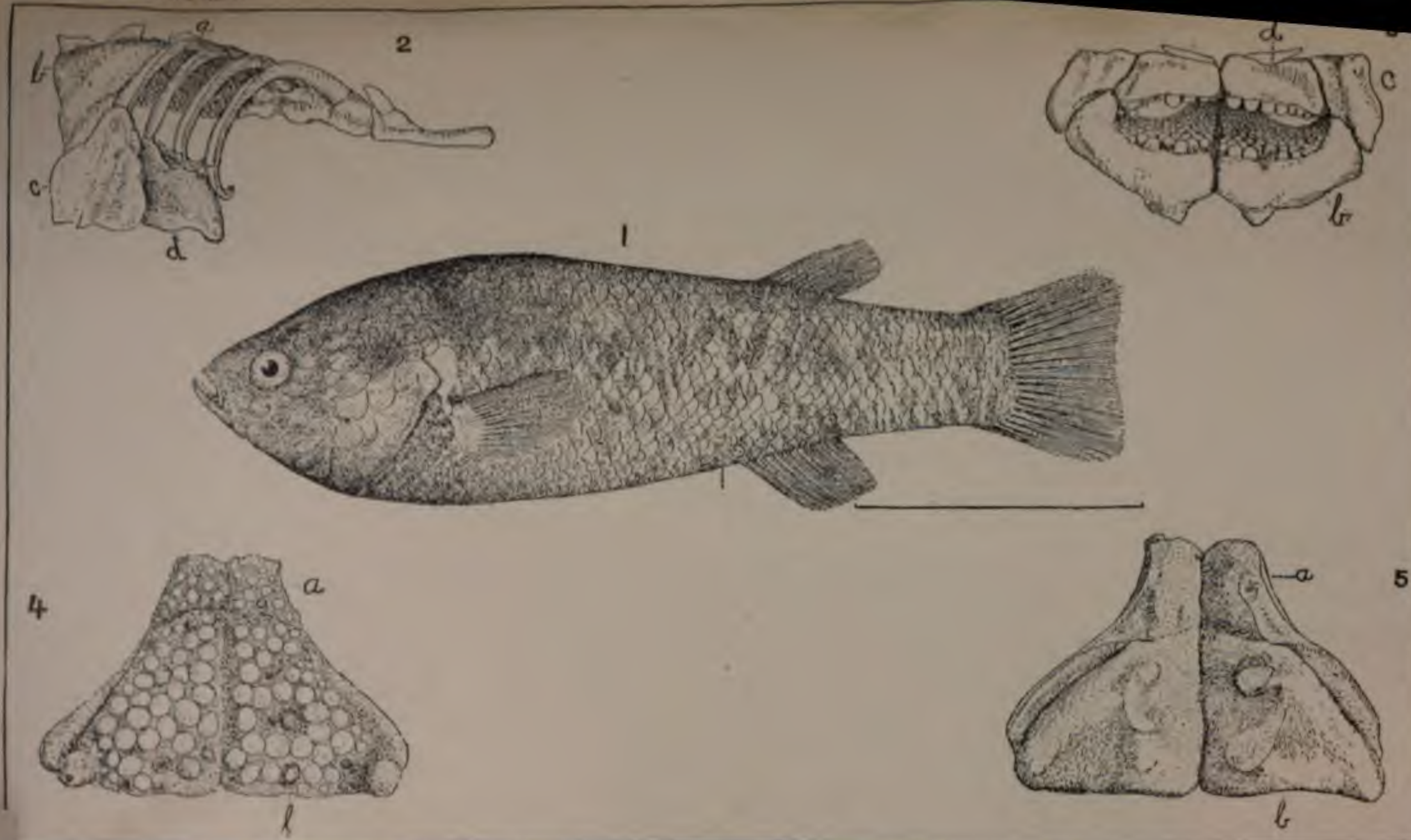
Fig. 3. Pharyngeals and gill arches from behind. (4½ times natural size.)

Fig. 4. Lower pharyngeals from above with adherent ceratobranchials of fourth gill arch. (5½ times natural size.)

Fig. 5. Same from below. (5½ times natural size.)

On all the figures—

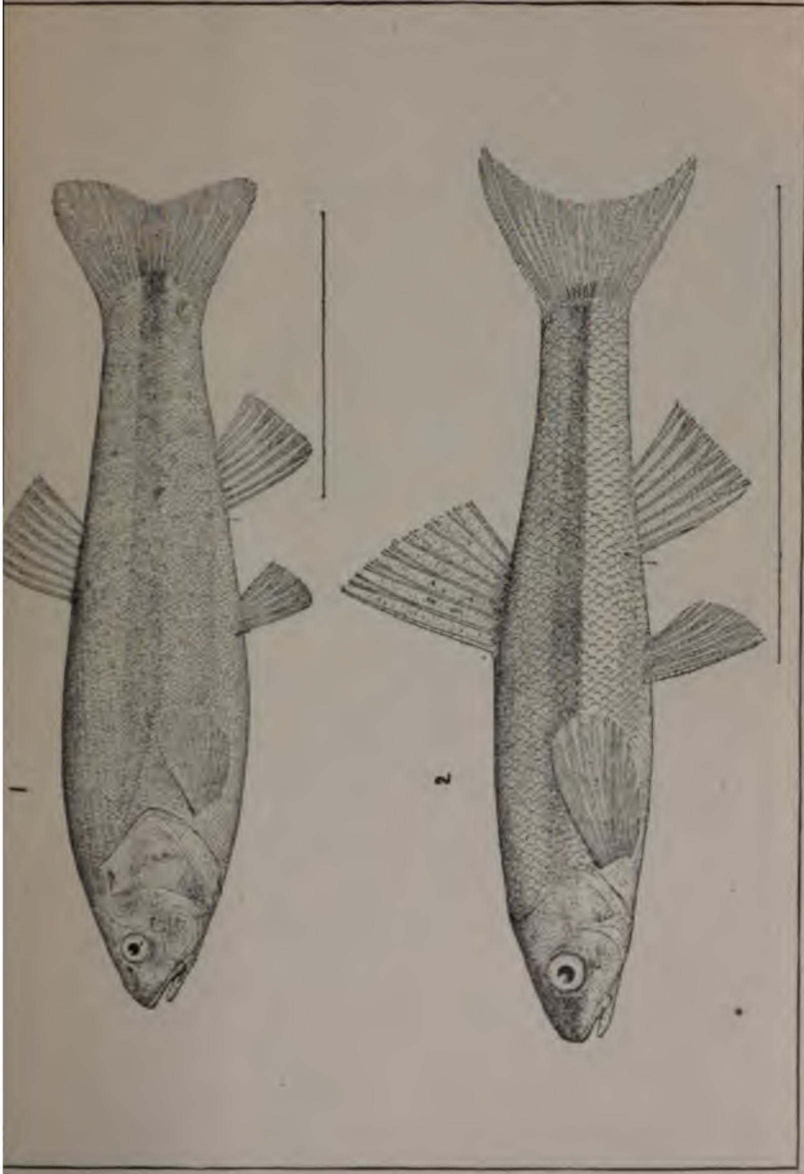
a represents ceratobranchials of fourth gill arch.
b represents lower pharyngeal bones.
c represents epibranchial of fourth arch.
d represents upper pharyngeal bones.



Empetrichthys merriami gen. et sp. nov. Type.

PLATE VI.

1. ***Rhinichthys*** **(*Apocope*)** ***nevadensis*** Gilbert, sp. **nov.**
   Type. Ash Meadows, Nevada.
2. ***Rhinichthys*** **(*Apocope*)** ***velifer*** Gilbert, sp. nov.
   Type. Pahranagat Valley, Nevada.



1. *Rhinichthys (Apocope) nevadensis* sp. nov. Type.
2. *Rhinichthys (Apocope) velifer* sp. nov. Type.

OPUNTIA ACANTHOCARPA. West slope Beaverdam Mountains, Utah.

OPUNTIA ACANTHOCARPA. West slope Beaverdam Mountains, Utah.

OPUNTIA PARRYI. Indian Spring Valley, Nevada.

OPUNTIA PARRYI. Indian Spring Valley, Nevada.

PLATE XI.

OPUNTIA RUTILA. West slope Beaverdam Mountains, Utah.

YUCCA BACCATA. Desert Mountains, Nevada.

YUCCA ARBORESCENS. Mohave Desert, California.

YUCCA MACROCARPA. Pahrump Valley, Nevada.
(Charleston Mountains in distance.)


MAP 5

GEOGRAPHIC DISTRIBUTION OF LECONTE'S THRASHER (*HARPORHYNCHUS LECONTEI*).

GEOGRAPHIC DISTRIBUTION OF LECONTE'S THRASHER (*HARPORHYNCHUS LECONTEI*).

GEOGRAPHIC DISTRIBUTION OF THE CREOSOTE BUSH (*LARREA TRIDENTATA*).

J O Snyder

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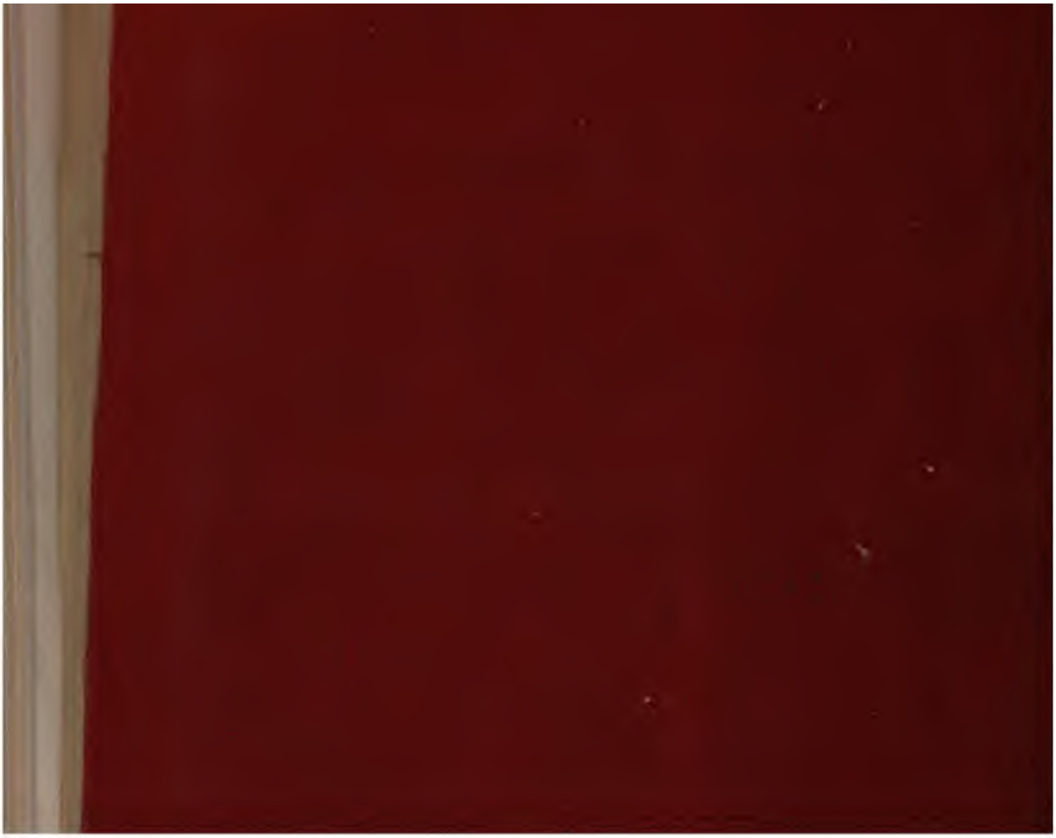

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., September 26, 1894.

SIR: I have the honor to transmit herewith, as No. 8 of North American Fauna, a Monographic Revision of the Family *Geomyidæ*, exclusive of the species of *Thomomys*.

In preparing a bulletin on the economic relations of the Pocket Gophers it became necessary to determine the status and geographic distribution of the various forms. This study developed the fact that the group was sorely in need of technical revision. The present paper is the outgrowth of an attempt at such a revision. It has grown so far beyond the limits originally intended that a large genus (*Thomomys*) has been of necessity omitted and will form the subject of a subsequent paper.

The results of the economic study of the group will appear as a separate bulletin prepared by my assistant, Mr. Vernon Bailey.

Respectfully,

C. HART MERRIAM,
Chief of Division of
Ornithology and Mammalogy.

Hon. CHAS. W. DABNEY, Jr.,
Acting Secretary of Agriculture.

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INTRODUCTION.

CHAPTER I.—GENERAL REMARKS.

CHAPTER II.—MORPHOLOGY OF THE SKULL.

CHAPTER III.—THE DENTAL ARMATURE.

THE TEETH.

(C.) TABLES OF CRANIAL MEASUREMENTS.

ILLUSTRATIONS.

PLATES.

TEXT FIGURES.

MAPS.

VISION OF THE POCKET GOPHERS, FAMILY GEOMYIDÆ, EXCLUSIVE OF THE SPECIES OF THOMOMYS.

By Dr. C. Hart Merriam.

INTRODUCTION.

The present paper is based on a study of the rich collection of Pocket phers belonging to the U. S. Department of Agriculture, comprising wards of 800 specimens, exclusive of the genus *Thomomys*. This terial has been supplemented by 110 specimens from my private col- tion, and a number from the U. S. National Museum,* making a total about a thousand specimens, among which are by far the greater num- of actual types known to be extant. The Department collection tains no less than 200 specimens from Mexico, most of which were ured by Mr. E. W. Nelson, a field naturalist of the Division. These, ether with a few highly interesting specimens from Costa Rica and atemala in the U. S. National Museum, have enabled me not only bring together for actual comparison all of the species previously cribed, and to add a considerable number heretofore unknown, but o to recognize several marked generic types whose existence had been suspected.

Critical study of this unparalleled wealth of material has led to the covery of some very remarkable dental peculiarities that have been med worthy of detailed description and illustration. Moreover, the portunity has been utilized to contribute a chapter on the morphol- of the skull, which it is hoped will prove of service to those inter- ed in the craniology of the Rodentia.

t is a matter of deep regret that the magnificent series of specimens living forms on which the present paper is based, has not been sup- mented by a single fossil; and it is earnestly hoped that an oppor- ity may yet be found to study the remains of the extinct animals t have been referred to the family—correctly or otherwise—in com- ison with the rich collection of living types now in our National seum. If the theory is correct, that the group has attained its atest expansion in the present age, we need not look to the rocks

*Placed at my disposal by the courtesy of Mr. F. W. True, Curator of Mammals.

for additional highly diversified types, but only for the links that bind the several phyla together and connect them with the more primitive forms from which they came. These would be of the utmost interest.

The author is indebted to Mr. F. W. True, Curator of Mammals in the U. S. National Museum, for the privilege of describing two species from Central America; to Dr. J. A. Allen, of the American Museum of Natural History, New York, for the privilege of examining the type of his *Geomys cherriei;* and to Mr. H. P. Attwater, of San Antonio, Texas, for the loan of a large series of the subspecies here described as *Geomys breviceps attwateri.* The author is under special obligations to Mr. Oldfield Thomas, Curator of Mammals in the British Museum, and to Dr. Paul Matschie, of the Royal Museum of Natural History in Berlin. Mr. Thomas has kindly compared specimens sent him for that purpose with his own types in the British Museum, and has also contributed measurements and other details of importance. Dr. Matschie has been good enough to remeasure the original types of Peters' *Geomys heterodus* and Lichtenstein's *Geomys mexicanus*, which specimens are still extant in the Berlin Museum, and has further taken the trouble to prepare and send me a table of cranial measurements of the skulls of these same types, with much other information of importance respecting them. And Dr. F. A. Jentink, the able director of the Leiden Museum, has done me the favor to send additional particulars about the Bullock specimen of *Geomys bursarius*, still extant in the Leiden Museum, which specimen has given rise to much controversy and is supposed to be Shaw's original type of the species.

From time to time during the preparation of the work, collectors have been sent to special localities from which new or supplemental material was desired, thus making it possible to settle many points that were originally in doubt. Much has been learned respecting the habits and mode of life of the animals from a living *Geomys lutescens* sent from Vernon, Texas, by my field assistant, Mr. J. Alden Loring. This animal was kept in confinement until sufficiently tame to permit handling freely and was the means of the discovery of a surprisingly large number of interesting facts that otherwise would have escaped detection.

Respecting the illustrations, the frontispiece was drawn by Mr. C. B. Hudson; plate 1 by Mr. Benjamin Mortimer; text figures 1 and 2 by Dr. George Marx; figures 5, 19, 63, 65, and 66 by Dr. James E. McConnell; and all of the outline camera lucida drawings of teeth by myself. Plates 2 to 19, inclusive, and all of the remaining text figures were drawn under my constant supervision by Mr. F. Müller. All of the twenty full-page plates have been reproduced by photolithography by Mr. Berthold Meisel, of Boston, and the text figures, with two or three exceptions, have been electrotyped from the originals by Mr. Harry C. Jones, of New York.

It will be observed that the generic names engraved on most of the plates (pls. 2–6, 8, and 10–16) do not agree with the generic names in the text. This misfortune is the result of having the plates printed before genera were finally segregated. The correct names are given in all ıs on the explanations facing the plates.

he literature relating to the group is rarely referred to in the present er, except for original descriptions. The reason is that previous ers have been based on insufficient material. To use them at all ld necessitate a large amount of explanation and criticism without esponding advantage.

ll the measurements in the present paper are in millimeters.

CHAPTER I.

GENERAL REMARKS.

The family *Geomyidæ*, comprising the mammals commonly known as Pocket Gophers, is confined to North America, where it ranges from the plains of the Saskatchewan in Canada southward to Costa Rica. It attains its highest development in the western United States and Mexico, and does not inhabit the region east of the Mississippi Valley except in the Gulf States, where it reaches the Atlantic coast in Florida and Georgia, but does not occur north of the Savannah River.

The appearance of a characteristic species is well shown in the frontispiece, and the peculiar aspect of the face in the accompanying cut (figs. 1 and 2), which shows the openings of the cheek pouches, wholly outside of the mouth, and also the pattern of the upper incisor teeth in two of the commonest genera, *Geomys* and *Thomomys*.

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FIG. 1.—Face of *Geomys bursarius*, showing grooved upper incisors and openings of cheek pouches.

FIG. 2.—Face of *Thomomys talpoides*, showing plane upper incisors and openings of cheek pouches.

All the members of the family spend their entire lives underground, and their whole organization is modified in accordance with the needs of a subterranean existence. The species, though numerous, are very much alike externally. They are short-legged, thickset animals, without an appreciable neck, without noticeable external ears, and with very small eyes. The feet are largely developed for digging. The fore paws in particular are very strong, are armed with long curved claws,* and the sides of the toes are lined with rows of bristles that evidently serve in preventing the dirt from

*The relative development of the claws is largely a matter of age and soil. They continue to increase in size throughout the life of the individual; their points are worn off in hard soil so that the claws become thick and blunt. In sandy soil they do not meet enough resistance to produce the usual wear, and, consequently, are longer and more slender than normal.

passing between the fingers (fig. 3), thus completing a more effective arrangement for keeping the tunnels clean, and for pushing the earth out of the openings in the burrows. The tail, which is of moderate length, is thick, fleshy, and usually devoid of hair, and is endowed with tactile sensibility.

FIG. 3.—Left fore foot of *Geomys personatus*, showing the rows of bristles which form brushes on the sides of the toes.

The Pocket Gophers, in working their way through the earth in the construction of their tunnels, use the powerful upper incisors as a pick to loosen the ground. At the same time the fore feet are kept in active operation, both in digging and in pressing the earth back under the body, and the hind feet are used also in moving it still further backward. When a sufficient quantity has accumulated behind the animal, he immediately turns in the burrow and by bringing the wrists together under the chin, with the palms of the hands held vertically, forces himself along by the hind feet, pushing the earth out in front. When an opening in the tunnel is reached the earth is discharged through it, forming a little hillock that resembles in a general way the hills thrown up by moles. In many species there is a naked callosity or 'nasal pad' over the anterior half of the nose, which must be of great assistance in the construction of the tunnels. When this callosity is largely developed the nasal bones underneath are highly arched or inflated, as in *Heterogeomys hispidus*.

PROGRESSION BACKWARD AS WELL AS FORWARD.

The *Geomys lutescens* already mentioned from Vernon, Texas, which I kept alive for several months, surprised me very much by running backward as rapidly and easily as forward. This method of progression was particularly noticeable when the animal was in his own quarters where he could follow a runway or an accustomed route. When carrying food to one of his storehouses he rarely turned around, but usually ran backward to the place of deposit, returning for more, and repeating the operation again and again, the to-and-fro movement suggesting a shuttle on its track. The well-known peculiarity of the external genitalia, which are so hidden and modified that the sexes are determined with difficulty, is doubtless the result of this habit, protecting the parts from injury when the animal is moving backward.

THE TAIL AN ORGAN OF TOUCH.

Throughout the family *Geomyidæ* the tail is rather large and fleshy, and as a rule is naked or scantily haired;* it varies in length in the

* The tail is naked in most of the southern species and is more or less covered with hair in the northern species. The latter have much more hair on the tail in winter than in summer.

various species from about 65 to 115 mm. The function of this peculiar appendage had long puzzled me, but by watching the live *Geomys* above mentioned as it ran backward in its runways I saw that it was used as an organ of touch. It is doubtless endowed with special tactile sensibility and is evidently of great value in warning the animals of the presence of an enemy in the rear when they are traveling backward in their dark tunnels. So far as I am aware this is the only instance in which the tail of a mammal is used for this purpose.

POSITION OF THE FORE FEET.

In walking on soft ground the fore feet are usually held in the normal position, with the soles down, or inclined slightly inward. In walking on hard ground, however, the fore feet are turned sideways, their soles facing one another, so that the claws curve inward, and the animal walks on the outer or ulnar side of the foot. This method of using the fore foot in walking on hard substances was frequently observed, and enables the animal to walk comfortably where the long curved claws would be in the way if held in the normal position. It was also frequently noticed that the feet were held in the same position (horizontally) when at rest, and when used as a scoop in pushing loads of earth or sand out of the way. When thus engaged the feet were drawn back under the breast, the wrists near together and the long claws turned outward. By moving the body quickly forward the animal always succeeded in throwing ahead of it a considerable quantity of loose earth.

DIVISION OF THE MOUTH INTO TWO CHAMBERS.

The lips and thin furry covering of skin are drawn into the broad space between the incisors and molars, where they meet in a raphe on the roof of the mouth and then separate again to meet around the under jaw, forming a diaphragm-like partition between the incisors and molars. The orifice is small and wholly inferior, and may be completely closed by the fleshy tongue or by the falling together of the furry lips, leaving a vertical slit between. The raphe or line of union of the lips on the roof of the mouth reaches most of the way from the incisors to the upper premolars. A narrow band, not covered with fur, connects the two lips inferiorly, crossing the floor of the mouth near the posterior end of the symphysis of the mandible. Thence the lips—if the term lips may be applied to this fold of skin—pass around the lower incisors, where the skin is attached posteriorly, so that it may be retracted, leaving a bare space below the point where the tooth protrudes from the alveolus, thus giving greater freedom to the lower incisors during the act of gnawing. During the to-and-fro drill-like motion of the jaw the skin probably remains nearly stationary, while the under incisors play rapidly back and forth. The object of the diaphragm-like partition which separates the mouth into two chambers is obviously to prevent dirt and chips from entering the mouth proper during the various subterranean operations of the animal.

THE TONGUE.

The tongue is short, thick, and fleshy. Its principal function doubtless is to keep the food between the crowns of the teeth during mastication. At other times it serves as a plug to stop the opening in the furry diaphragm between the incisors and molars.

THE CHEEK POUCHES.

All of the Pocket Gophers are provided with external cheek pouches, which open on the sides of the face outside of the mouth, and are covered with fur inside. These cheek pouches are used exclusively in carrying food, and not in carting dirt as often erroneously supposed. The animals are great hoarders and carry away to their storehouses vastly more than they consume. The cheek pouches reach back as far as the shoulder and are so attached that they can not be completely everted without rupture of their connections. While the posterior part of the sack is held back by the muscle which stretches thence to the lumbar vertebræ, the skin of the inner side of the pouch, which covers the side of the face below the eye and in front of the ear, may be everted or prolapsed, hanging down as a flap below the corners of the mouth. This is probably what happened in the case of snake fright observed by Dr. A. K. Fisher at Ellis, Kansas, in June, 1893. Dr. Fisher saw a gopher snake (*Pituophis*) about 5 feet in length hunting for breakfast. He says: "Presently the snake glided into a gopher hole. In a few minutes I saw a gopher (*Geomys lutescens*) run out as fast as possible from the other end of the line of hills. I soon caught up to it. It appeared very much frightened, and its cheek pouches were hanging out. The gopher evidently had only scented the snake, for it was apparent that the snake had not seen the mammal, as it came out of the hole by which it entered and glided off deliberately in another direction."

HOW GEOMYS PUTS FOOD INTO ITS CHEEK POUCHES.

A live *Geomys* from Vernon, Texas, has been carefully observed for the purpose of ascertaining how the reserve food is placed in the cheek pouches. The animal soon became sufficiently tame to eat freely from the hand, and was commonly fed bits of potato, of which he was particularly fond. The manner of eating was peculiar and interesting, and showed an ability to use the huge fore feet and claws in a way previously unsuspected. After satisfying the immediate demands of hunger it was his practice to fill one or both cheek pouches. His motions were so swift that it was exceedingly difficult to follow them with sufficient exactness to see just how the operation was performed. If a whole potato was given him, or a piece too large to go into the pouch, he invariably grasped it between the fore paws and proceeded to pry off a small piece with the long lower incisors. He would then raise himself slightly on his hind legs and hold the fragment between his fore paws while eating, for he usually ate a certain quantity before putting any into the pouches. If small pieces were given him he took them promptly and passed them quickly into the pouches. Some pieces were thus disposed of at once; others were first trimmed by biting off projecting angles. As a rule one pouch was filled at a time, though not always, and the hand of the same side was used to push the food in. The usual course is as follows: A piece of potato, root, or other food is seized between the incisor teeth, and is immediately transferred to the fore paws, which are held in a horizontal position, the tips of the claws curving toward one another. If the food requires reduction in size, the trimming is done while held in this position. The piece is then passed rapidly across the side of the face with a sort of wiping motion which forces it into the open mouth of the pouch. Sometimes a single rapid stroke with one hand is sufficient; at other times both hands are used, particularly if the piece is large. In such cases the long claws of one hand are used to draw down the lower side of the opening, while the food is poked in with the other. It is obviously impossible for the animal to pass food from the mouth to the pouches without the aid of its fore claws.

The most remarkable thing connected with the use of the pouches is the way they are emptied. The fore feet are brought back simultaneously along the sides of the head until they reach a point opposite the hinder end of the pouches; they are then pressed firmly against the head and carried rapidly forward. In this way the contents of the pouches are promptly dumped in front of the animal. Sometimes several strokes are necessary. I am not prepared to say that the animal can not empty the pouches by means of the delicate investing muscles, but I have never seen them emptied in any other way than that here described.

THE FOOD.

The food consists chiefly of roots, tubers, and other rather hard vegetable substances, though grass and the succulent parts of plants are sometimes eaten. In agricultural districts the animals are highly injurious, destroying potatoes and other tubers in large quantities, and gnawing off the roots of fruit trees. In fields of grain and fodder they sometimes do considerable damage by the aggregate area covered by the little mounds of earth thrown up from the tunnels.

COLOR PHASES.

In most species of the *Geomyidæ* two color phases occur, a plumbeous or dusky phase and a chestnut-brown or yellowish-brown phase. The latter varies greatly in the different species—from pale straw color or buffy ochraceous in *Thomomys perpallidus* of the Colorado and Mohave deserts, to dark liver-brown in *Geomys bursarius* of the Upper Mississippi Valley. Taking the group as a whole, the brown phase is by far the commonest and may be regarded as normal; but in certain species in nearly all the genera the plumbeous phase prevails, as in *Thomomys orizabæ*, *Platygeomys fumosus*, and *Zygogeomys trichopus*—all from southern Mexico. The plumbeous pelage is commonly more or less metallic and sometimes even iridescent. It is rare in the United States species, though common in *Thomomys nevadensis* from central Nevada and *Geomys breviceps* from Louisiana. It has not yet been observed in *Cratogeomys castanops* or *Geomys lutescens*, and the red pelage has not been observed in *Zygogeomys trichopus*. So far as known, only a single color phase occurs in the genera *Heterogeomys* and *Orthogeomys*, both of which are dark seal brown in fresh pelage and a dull faded brown in worn pelage.

Seasonal differences in coloration.—Some of the species vary but little with season, as *Geomys bursarius* from the Upper Mississippi Valley; still even this animal is considerably darker in winter than in summer. Others present two well-marked color phases, according to season. In the latter category are *Geomys lutescens*, *breviceps*, and to a less degree *personatus* also. In *lutescens* the summer pelage differs from the winter in the absence of the dark dorsal band which is usually present from October to April or May, and sometimes even as late as June. Apparently the absence of this stripe in summer specimens is sometimes due to wear, the dark tips of the hairs when worn leaving the pale subapical zone exposed. This can not always be the case, however, since one specimen from Chadron, Nebraska, collected April 30, has the dorsal stripe plumbeous throughout with but a faint trace of the pale subapical zone.

In typical *Geomys breviceps*, and also in specimens from the western limit of the range of the species where it seems to be shading toward *lutescens* and *texensis*, the same thing occurs, though the renewal of the pelage takes place at a somewhat different date. This is very apparent in specimens from Gainesville, in the valley of the Red River in northeastern Texas. A specimen taken August 10 has a broad dark dorsal band, while two specimens taken March 27 and March 29 show no trace of this band except on the head, the back being a uniform reddish brown more or less mixed with dusky.

SEXUAL VARIATION.

Sexual variation is marked throughout the genus and in some species is extraordinary. It may be conveniently discussed under two heads, (1) difference in size; (2) difference in cranial characters.

(1) *Difference in size.*—The females are always considerably smaller than the males; the discrepancy is greater in some species than in others. Reference to the tables of measurements shows that the dif-

ference in total length often amounts to 25 or 30 mm.; in length of tail to 12 or 15 mm.; and in hind foot 3 or 5 mm. The difference in the size of the skull is equally marked, and is well shown in the tables of cranial measurements.

(2) *Difference in cranial characters.**—Independent of the conspicuous differences in size between male and female skulls of the same species from the same locality, other and more important differences exist which not infrequently prove troublesome in identifying specimens, particularly if skulls of both sexes are not at hand for comparison. The female as a rule has the brain case broader and flatter, the zygomata narrower and less angular, the jugal narrower anteriorly, the rostrum and nasals shorter, and the skull as a whole smoother. In other words, the cranium of the female is much less specialized than that of the male and often points suggestively to the stock from which the species was derived. It thus happens in the case of series of species in which the successive forms in the development of a particular type are still extant (as in the *texensis-bursarius* series) that the female resembles the male of the species next below in the line of descent more than the male of her own species.

In several forms in which the males have well developed sagittal crests, the females have a sagittal area bounded by distant temporal impressions; and in species in which the males have prominent temporal ribs, the females commonly have more widely separated temporal impressions which rise as ridges from the outer side but not from the inner side, the interspace being more or less thickened.

INDIVIDUAL VARIATION.

The family *Geomyidæ* presents the usual range of individual variation, both in size and in cranial characters. While the male and female skulls of a species agree very well among themselves, showing strong average characters, there are in every large series one or two skulls which depart from the type in one or more particulars. These departures are most common in the form and manner of ending of the nasals and ascending branches of the premaxilla. In all such cases sexual differences should be carefully eliminated before assuming that the departure is individual.

Individual variation is always more marked in the secondary or accessory cranial structures than in the more important and less variable elements. Thus the peripheral processes and expansions for the attachment of muscles are always more variable than other parts of the skull. The degree of lateral production of the squamosal, and of the angular process of the mandible in *Platygeomys gymnurus*, and the variations in

* The sexual organs are so arranged in the *Geomyidæ* as to be difficult of determination in the flesh, except during the rutting season; hence the sex marks on labels may be safely ignored if they conflict with the cranial characters.

detail of the occipital basin, are illustrations of this kind. Still, in studying large series of skulls of a single species, one is much more deeply impressed by the strong tendency toward the development in each bone of a particular type of form than by the departures therefrom.

The animals continue to grow for several years, so that the majority of breeding individuals are still far from the full size of their species. This is very apparent in the skulls, which not only continue to increase in actual size but also, in many species, in the ratio of zygomatic breadth to length, and in the development of ridges and processes for muscular attachments.

SUBDIVISIONS OF THE FAMILY GEOMYIDÆ.

A superficial examination of the skulls of the various species of *Geomyidæ* is sufficient to show the existence of several widely different types. Heretofore the common practice has been to divide the family into two genera, *Thomomys* and *Geomys*, according to the absence or presence of distinct grooves in the upper incisors, and to subdivide the genus *Geomys* into two series, unisulcate and bisulcate. The number of grooves was believed to be correlated with certain cranial characters, the members of the unisulcate series having widely spreading zygomatic arches, the outer angles of which were broadly expanded, while the bisulcate series had narrower arches and lacked the expansion; but no attempt was made to separate them, even subgenerically. The recent discovery of a large number of new forms in Mexico and Central America, comprising several highly diversified types, renders this classification inadequate. After subtracting the strongly marked genus *Thomomys*, which differs from all the others in numerous important characters heretofore overlooked, a heterogeneous assemblage remains, comprising the animals commonly lumped under the generic name *Geomys*, and also the new forms here first described. Of these, the bisulcate series may be divided into two very distinct and two minor types, while the unisulcate series contains at least six well-marked subdivisions.

In attempting a logical classification of the group, one is met at the outset by the difficulty that some of the specialized or peripheral types are more or less closely connected with the trunk line by existing intermediate forms, making it exceedingly difficult to draw hard and fast lines without unnecessary subdivision. The genus *Geomys* as here restricted is such a case. It comprises two quite distinct branches, *Geomys tuza* and *G. bursarius*, which are connected with one another and with the trunk line, or something very near it, by a series of generalized species, the *texensis-breviceps* series. In cases of this kind two courses are open, either to separate the extreme peripheral forms from the less specialized species leading up to them, or to unite the entire branch under a single genus. The latter course has been followed in the present instance. But each case must be decided on its merits. One that has been treated differently is the large limb whose ends, as now known, are represented by two of Mr. Thomas's species, *bulleri* and *merriami;* the former is not far removed from the trunk line of the group; the latter is one of the terminal branches. But the two forms differ in cranial and dental characters of great weight, and are furthermore separated by an enormous gap which is not bridged at any point by any of the species yet discovered. For these reasons they are treated as independent genera. Still another reason for this course, if another were needed, is the circumstance that the branch ending in *merriami* is only one of four equally specialized terminal boughs, all apparently springing from and bearing the same relation to the single limb or main stem whose base is marked by *bulleri.*

In dividing the family into genera the aim has been to select as types the most specialized peripheral forms and to assemble around them the less specialized species. A study of the enamel pattern of the molariform teeth shows that the *Geomyidæ* may be divided primarily into five groups, several of which are of supergeneric value, and a study of the fundamental cranial characters leads to the recognition of nine genera. By means of the following brief key, any of the species now known may be easily referred to its proper genus without cutting the skull:

KEY TO GENERA.

(1) NO ENAMEL ON POSTERIOR FACE OF UPPER PREMOLAR.

Posterior enamel plate present on first and second upper molars.
  Upper incisor bisulcate.. *Geomys.*
  Upper incisor unisulcate
    Frontal strongly constricted (biconcave) between orbits..... *Pappogeomys.*
    Frontal not constricted between orbits; very broad.......... **Orthogeomys.*
Posterior enamel plate absent in first and second upper molars.
  Breadth of cranium across squamosals much less than zygomatic breadth; lambdoid crest not sinuous (simply convex posteriorly); angle of mandible short..................... *Cratogeomys.*
  Breadth of cranium across squamosals greater than zygomatic breadth; lambdoid crest strongly sinuous; angle of mandible very long.................................... *Platygeomys.*

(2) ENAMEL PRESENT ON POSTERIOR FACE OF UPPER PREMOLAR.

Posterior enamel plate of upper premolar restricted to inner side.
 Posterior enamel plate present and complete on first and second upper molars.
  Frontal not constricted between orbits; very broad; pterygoids long... **Orthogeomys.*
  Frontal strongly constricted between orbits; pterygoids short.
    Postorbital process absent; palatopterygoids long and slender (pterygoid part narrow)............................ *Heterogeomys.*
    Postorbital process strongly marked; palatopterygoids short and broad (pterygoid part very broad).................. *Macrogeomys.*

**Orthogeomys* presents an exceptional condition of the enamel pattern of the upper premolar. The posterior enamel plate of this tooth is evidently disappearing; it is present on the inner side in *O. latifrons,* but is altogether absent or reduced to a very narrow strip in *O. grandis* and *scalops.*

Posterior enamel plate of upper premolar complete.

Posterior enamel plate present on inner (lingual) side only of first and second upper molars.

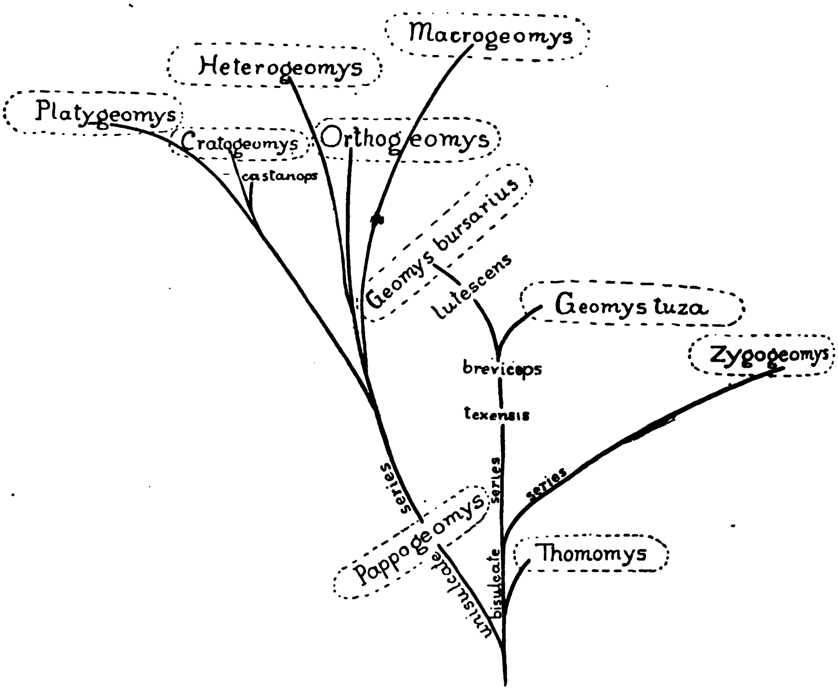
Zygomatic arch complete without jugal (jugal inferior); incisors bisulcate .... *Zygogeomys.*

Posterior enamel plate present and complete on first, second, and third upper molars.

Incisors not grooved, or with a single fine sulcus on inner side.. *Thomomys.*

PHYLOGENETIC TREE OF THE GENERA.

The accompanying phylogenetic tree is intended to represent the author's conception of the interrelations of the nine living genera of



Phylogenetic tree of the Geomyidæ.

the *Geomyidæ* now known. It is introduced with a full knowledge of the modern tendency to disregard and even belittle such attempts; but I am aware of no way in which the results of painstaking research respecting the affinities of organisms may be expressed so graphically. Apparently there were four forks to the early *Paleo-Geomine* phylum: one running into *Thomomys*, another producing the bisulcate series of *Geomys*, beginning with *texensis* or *arenarius* and ending in *bursarius;* the third developing the anomalous bisulcate *Zygogeomys;* the fourth, a strictly unisulcate series, of which *bulleri* and *albinasus* are the least specialized forms now known, splitting into four very distinct branches, each of which now forms a well-marked genus. In the case of the branch leading up to *Geomys bursarius* the series of living forms is practically complete; in the case of the other branches the connecting links are unknown. It is evident that both *Pappogeomys bulleri* and *Geomys texensis* branched off from points not very remote from the place where *Thomomys* left the trunk line, and that they have undergone relatively little modification since.

The evolution of some types takes place in a very direct way, apparently by uninterrupted progress in a definite direction, and the species comprising such a series, as *texensis*, *breviceps*, *lutescens*, and *bursarius*, may be looked upon as stages in the evolution of the type. The origin of other types is more circuitous and less easily understood. Fortuitous variations lead to the appearance of numerous side branches, most of which abort before developing any very pronounced individuality. Others are more fortunate. Chancing to fit some phase of the environment previously unutilized, they go on until a maximum of departure compatible with the balance of the organism as a whole is attained. There are several of these highly specialized departures from the main stem in the *Geomyidæ*, such as *Cratogeomys*, *Platygeomys*, *Macrogeomys*, and *Zygogeomys*.

LIST OF THE GENERA AND SPECIES.

Genus GEOMYS Rafinesque.

Name of species.	Type locality.
Geomys tuza (Ord)	Augusta, Georgia.
tuza floridanus (Aud. and Bach.)	St. Augustine, Florida.
tuza mobilensis subsp. nov	Mobile Bay, Alabama.
bursarius (Shaw)	Minnesota?
lutescens Merriam	Western Nebraska.
breviceps Baird	Mer Rouge, Louisiana.
breviceps sagittalis subsp. nov	Galveston Bay, Texas.
breviceps attwateri subsp. nov	Rockport, Aransas County, Texas.
texensis sp. nov	Mason, Texas.
arenarius sp. nov	El Paso, Texas.
personatus True	Padre Island, Texas.
personatus fallax subsp. nov	Corpus Christi, Texas.

Genus PAPPOGEOMYS nob.

Pappogeomys bulleri (Thomas)	Talpa, Mascota, Jalisco, Mexico.
albinasus sp. nov	Guadalajara, Jalisco, Mexico.

Genus CRATOGEOMYS nob.

Cratogeomys merriami (Thomas)	Valley of Mexico.
perotensis sp. nov	Cofre de Perote, Mexico.
estor sp. nov	Las Vigas, Vera Cruz, Mexico.
peregrinus sp. nov	Mount Iztaccihuatl, Mexico.
oreocetes sp. nov	Mount Popocatapetl, Mexico.
castanops (Baird)	Las Animas, Colorado.
castanops goldmani subsp. nov	Cañitas, Zacatecas, Mexico.
fulvescens sp. nov	Chalchicomula, Puebla, Mexico.

Genus Platygeomys nob.

Platygeomys gymnurus Merriam	....	Zapotlan, Jalisco, Mexico.
tylorhinus sp. nov	....	Tula, Hidalgo, Mexico.
planiceps sp. nov	....	Northern slope Volcan Toluca, Mexico.
fumosus Merriam	....	Colima City, Colima, Mexico.

Genus Orthogeomys nob.

Orthogeomys scalops (Thomas)	....	Tehuantepec, Mexico.
grandis (Thomas)	....	Dueñas, Guatemala.
latifrons sp. nov	....	Guatemala.
nelsoni sp. nov.	....	Mt. Zempoaltepec, Oaxaca, Mexico.

Genus Heterogeomys nob.

Heterogeomys hispidus (LeConte)	....	Near Jalapa, Vera Cruz, Mexico.
torridus sp. nov	....	Chichicaxtle, Vera Cruz, Mexico.

Genus Macrogeomys nob.

Macrogeomys heterodus (Peters)	....	Costa Rica.
dolichocephalus sp. nov	....	San José, Costa Rica.
costaricensis sp. nov	....	Pacuare, Costa Rica.
cherriei (Allen)	....	Santa Clara, Costa Rica.

Genus Zygogeomys nob.

Zygogeomys trichopus sp. nov	....	Nahuatzin, Michoacan, Mexico.

GEOGRAPHIC DISTRIBUTION OF THE FAMILY AND GENERA.

The area inhabited by the family *Geomyidæ* stretches from the dry interior of British Columbia and the Plains of the Saskatchewan southward to Costa Rica. In an east and west direction the group covers the continent from ocean to ocean, except that it is absent from the region north of the Savannah River and east of the Mississippi Valley, as shown by the accompanying maps (maps 1, 2, and 3). The group is clearly of Sonoran origin and reaches its highest development on the southern part of the table-land of Mexico. The great majority of the species inhabit the upper and lower Sonoran zones, though a few specially modified forms range upward on favorable mountain sides through the Transition and even into the lower edge of the Boreal zone. On the other hand, two species inhabit the tropical belt of Mexico.

Distribution by genera.—The present distribution of the genera coincides very nicely with their systematic relations.

The genus *Thomomys* (map 1, A) has by far the most extended range of any single genus, inhabitating suitable localities from the valley of Mexico and Mount Orizaba northward to British Columbia and the North Saskatchewan river, and from the Pacific coast eastward to the Great Plains.

The genus *Geomys* (map 1, B and B′) inhabits a broad belt across the middle part of the United States, from the Red River Valley in northwestern Minnesota and northeastern North Dakota southward to the

Mexican boundary along the Rio Grande; and also the southern half of Alabama and Georgia, and the northern half of Florida. The genus does not occur west of eastern Wyoming, east-central Colorado, and the Rio Grande Valley in New Mexico. (See also map 4.)

The genus *Cratogeomys* (map 2) inhabits the Great Plains of the United States from the Arkansas River in eastern Colorado southward, and the eastern table-land region of Mexico to its extreme southern edge in the States of Mexico and Puebla.

The genus *Pappogeomys* (map 3^1) is known only from the State of Jalisco in Mexico.

The genus *Platygeomys* (map 3^2) inhabits a rather narrow belt along the southern border of the Mexican table-land in the States of Jalisco, Colima, Michoacan, Mexico, and Hidalgo.

The genus *Orthogeomys* (map 3^5) inhabits elevated parts of the States of Oaxaca and Chiapas, in extreme southern Mexico and adjacent parts of Guatemala.

The genus *Heterogeomys* (map 3^4) inhabits the tropical plains of Vera Cruz, below the edge of the table-land, and extends thence southerly to Coban in Guatemala, probably following the low coastal plain of Tabasco to the Rio Usumacinta and thence up the valleys of the San Pedro and its tributaries to the interior of Guatemala.*

The genus *Macrogeomys* (map 3^6) inhabits the highlands and mountains of Costa Rica and is not known elsewhere.

The genus *Zygogeomys* (map 3^3) inhabits the Sierra Madre of the State of Michoacan on the southern part of the table-land of Mexico.

NUMBER AND DISTRIBUTION OF THE SPECIES.

Omitting the genus *Thomomys*, the number of species recognized by Baird in 1857 was 7, as follows: *G. bursarius*, *breviceps*, *pinetis* [=*tuza*], *clarkii*, *castanops*, *hispidus*, and *mexicanus*. The number recognized by Coues twenty years later, in 1877, was 5, as follows: *G. bursarius*, *tuza*, *castanops*, *hispidus*, and *mexicanus*. Coues degraded 2 of Baird's species to synonomy, uniting *breviceps* with *bursarius*, and *clarkii* with *castanops*. The same fate overtook *G. heterodus* of Peters, described in the interval between Baird and Coues; it was made a synonym of *hispidus*.

The number of species and subspecies recognized in the present paper is 37, of which 21 are described as new. The remaining 16 are accounted for as follows: Four out of the 5 admitted by Coues are retained, namely, *bursarius*, *tuza*, *castanops*, and *hispidus*, but the fifth, *mexicanus*, is rejected as preoccupied by an unidentifiable species (see

* While this paper is passing through the press, a specimen of *Heterogeomys* has been received from Mr. Nelson, collected by him at Reyes, about 50 miles north of the city of Oaxaca, in the State of the same name, and 33 miles south of the boundary of Vera Cruz and Puebla.

postea, p. 200). Baird's *breviceps* and Peters's *heterodus* are reinstated as valid species, and *floridanus* of Audubon and Bachman is admitted as a subspecies of *tuza*. The remaining 9 have been described since the publication of Coues's Monograph—in fact, during the past five years—and no less than 6 of them are from Mexico and Guatemala. These species are: *personatus* of True; *bulleri*,* *grandis*, *scalops*, and *merriami* of Thomas; *lutescens*, *fumosus*, and *gymnurus* of Merriam, and *cherriei* of Allen. Of the 21 new forms here described, 6 are from the southern United States (1 from Alabama and 5 from Texas), 12 from southern Mexico, 2 from Costa Rica, and 1 from Guatemala. Of the total number here recognized (37), 10 are restricted to the United States; 2 (probably 3†) are common to the United States and northern Mexico; 17 are restricted to the southern half of Mexico; 2 are common to southeastern Mexico and adjacent parts of Guatemala, and 5 are known from Guatemala and Costa Rica only. Thus no less than 24 species, representing, as will be shown later, 7 distinct groups or genera, are absolutely confined to southern Mexico and northern Central America. The extraordinary and unexpected richness of this part of tropical America in members of the group,‡ and the even more remarkable diversity of structure presented by the various types, are of the utmost interest in view of the time and place of origin of the family to which they belong.

UNITED STATES SPECIES.

The Pocket Gophers of the United States fall naturally into two principal subdivisions, (1) those having the upper incisors deeply marked by a median longitudinal furrow (*unisulcate series*), and (2) those having the upper incisors double grooved, a narrow sulcus on the inner margin of the tooth and a larger and deeper one near the middle (*bisulcate series*). The unisulcate series is represented by a single species, *castanops* of Baird, which inhabits the western plains from middle Colorado southward into Mexico. The members of the bisulcate series inhabit-

* *G. bulleri* was described almost simultaneously by Mr. Thomas and myself, but Mr. Thomas's description was issued first and his name *bulleri* has priority over my name *nelsoni*.

†These are *Geomys arenarius*, which is common on both sides of the Rio Grande at El Paso, Texas, and Juarez, Mexico, and *Cratogeomys castanops*, which inhabits extensive areas in western Texas and Chihuahua. A third species, *Geomys personatus*, inhabits the lower Rio Grande region in Texas and in all probability occurs on the Mexican side also (in the state of Tamaulipas).

‡When it is remembered that only about half a dozen specimens, all told, have been examined from Costa Rica and Guatemala, as compared with 200 from Mexico, it must be evident that the possibilities of Central America have been by no means exhausted. Furthermore, no specimens have been seen from Yucatan, though the family is represented there by at least one species. (Biologia Centrali-Americana, Mammalia, 1880, p. 160.)

ing the United States are 12 in number. These, with their type localities, are as follows:

Geomys tuza (Ord)	Augusta, Georgia.
tuza floridanus Bach.	St. Augustine, Florida.
tuza mobilensis subsp. nov	Mobile Bay, Alabama.
bursarius (Shaw)	Minnesota ?.
lutescens Merriam	Birdwood Creek, western Nebraska.
breviceps Baird	Mer Rouge, Louisiana.
breviceps sagittalis subsp. nov	Galveston Bay, Texas.
breviceps attwateri subsp. nov	Rockport, Aransas County, Texas.
texensis sp. nov	Mason, Texas.
arenarius sp. nov	El Paso, Texas.
personatus True	Padre Island, Texas.
personatus fallax subsp. nov	Corpus Christi, Texas.

Geomys bursarius is the common Pocket Gopher of the northern Mississippi Valley, from eastern North Dakota and western Minnesota south to southeastern Missouri. It is a dark liver-colored animal with pure white forefeet, in sharp contrast to the color of the surrounding parts, and has the longest claws of any of the bisulcate species.

Geomys lutescens is a pallid form of the *bursarius* type, inhabiting the arid sand hills of western Nebraska and extreme eastern Wyoming, and ranging thence southerly into northwestern Texas.

Geomys breviceps inhabits the alluvial lands of Louisiana, Arkansas, and eastern Texas, the typical form coming from Prairie Mer Rouge, in Morehouse Parish. It extends thence northwesterly up the valley of the Arkansas River nearly to the Kansas border. It is a rather small dark species. On the south, along the coast region of Texas, it splits up into the two following subspecies:

Geomys breviceps sagittalis inhabits the gulf coast of Texas about Galveston Bay. It is smaller than true *breviceps*.

Geomys breviceps attwateri inhabits the coastal plain and islands of Texas, from Nueces Bay northward to Matagorda Bay, and ranges into the interior nearly to San Antonio. It is considerably larger than typical *breviceps*.

Geomys texensis in its typical form inhabits central Texas. On the north and northwest it probably passes into *lutescens*, while on the east it may intergrade with *breviceps*. It is much smaller than *bursarius* or *lutescens* and has a pure white belly. Its upper parts are reddish-brown, paler than *bursarius*, but darker and brighter than *lutescens*.

Geomys arenarius inhabits a very restricted area in the upper Rio Grande Valley in extreme northern Chihuahua, western Texas, and southern New Mexico. So far as known it is completely isolated, not coming in contact with any other bisulcate species. It is of medium size, has a relatively long tail, and the upper parts are drab.

Geomys personatus inhabits Padre Island and the adjacent coast of Texas from Santa Rosa southward, extending inland as far as Carrizo, on the Rio Grande; its range, together with that of its subspecies *fallax*, thus coincides with the northern arm of the arid tropical belt along the

Gulf coast. In external appearance *personatus* much resembles *G. lutescens* of the Great Plains, from which it may be distinguished at once by its larger size, larger and more naked tail, and by important cranial characters.

Geomys personatus fallax inhabits a small area on the Gulf coast of Texas, immediately south of Nueces Bay. It is smaller and darker than true *personatus*.

Geomys tuza, a rather large cinnamon-brown species, inhabits the pine barrens of eastern Georgia, where it is locally known as the 'Salamander.' The same name is applied to the following subspecies:

Geomys tuza floridanus is a Florida form of *tuza*, as its name indicates, and does not differ materially in external appearance.

Geomys tuza mobilensis inhabits southern Alabama and northwestern Florida and is a strongly marked form. It is very much darker than *tuza*. (For distribution of United States species see map 4).

DISTRIBUTION OF THE MEXICAN SPECIES.

At my request Mr. Nelson has prepared the following note, embodying his personal knowledge of the geographical and vertical distribution of the species obtained by him in Mexico, exclusive of the genus *Thomomys*:

"One of the most remarkable and interesting features connected with the Mexican Pocket Gophers is the small area within which most of the known species occur. This area is a belt about 400 miles in length by 60 in breadth, stretching from the Pacific coast to the Gulf of Mexico, between the nineteenth and twentieth parallels of north latitude. It contains the thirteen highest peaks of Mexico,* all of which attain an altitude of 12,000 feet or upward. The most notable of these are Iztaccihuatl (17,000 feet), Popocatapetl (17,523 feet), and Orizaba (18,314 feet).†

*The only peak in Mexico attaining an altitude exceeding 12,000 feet, in addition to those here enumerated, all of which lie in the *Geomys belt*, is Mount Zempoaltepec, in the State of Oaxaca. This peak is said to reach 12,000 feet, and is inhabited by a new species of gopher here named *Orthogeomys nelsoni*.

†The complete list with approximate altitudes, beginning at the westernmost, is as follows:

	Feet.	
Sierra Nevada de Colima	14,000,	State of Jalisco.
Volcano de Colima	12,000,	Do.
Pico de Tancitaro	12,653,	State of Michoacan
Pico de Patamban	12,290,	Do.
Volcano de Toluca	15,000,	State of Mexico.
Cerro de Ajusco	12,000,	Do.
Popocatapetl	17,523,	State of Puebla.
Iztaccihuatl	17,000,	Do.
Cerro de Telapon	13,575,	Do.
Cerro de Malinche	13,462,	State of Tlaxcala.
Orizaba	18,314,	State of Puebla.
Sierra Negra	15,000,	Do.
Cofre de Perote	14,000,	State of Vera Cruz

"The main chain of the Cordillera or Sierra Madre extends along this line and forms here the southern limit of the plateau or table-land region. The mountains throughout this district are of volcanic origin. They inclose numerous high valleys, such as that of Toluca (8,600 feet) and the valley of Mexico (7,400 feet). The main body of the range takes the form of high rounded ridges between 7,000 and 9,000 feet in altitude. On the north the ridges slope down to the adjacent tablelands; on the south a longer slope carries their bases into the low hot valleys of the streams that lead out to the sea. The average elevation of the belt under discussion is far greater than that of any other equal area in Mexico or Central America; this belt also contains the only peaks of the region that are permanently capped with snow.

"The characteristic trees of all these mountains are pines, firs, and alders. In descending toward the hot coast country, below 7,000 feet, oaks come in, and as the descent is continued they in turn give way before the subtropical and tropical species. Although most of the area within the limits given is high and cool, yet at each end a sharp descent leads to the low, hot coast country.

"Gophers occur throughout this area, from the hot coast districts up to the scattered vegetation about timber line. *Geomys fumosus*, the extreme westernmost species, burrows in the damp clayey soil among the cocoanut palms about the city of Colima, at an altitude of from 1,000 to 2,500 feet. *Geomys hispidus*, the easternmost representative of the group, inhabits the coffee and sugar-cane fields of Vera Cruz. In the intervening district the other species range from 4,000 feet up to timber line. Although several reach as high as 12,500 or even 13,000 feet, the great majority of individuals of all species occur below 9,000 feet, and a vertical section of the country from 4,000 to 9,000 feet would include all of the species and nearly all of the individuals of the interior forms. By far the greatest development of the group is reached between the altitudes of 6,000 and 8,500 feet. This area is along the lower border of the pine and oak forest and reaches out along the adjacent treeless plains for a short distance. Considered faunally, this area is Upper Sonoran and Transition. The northern base of this part of the Cordillera forms the southern limit of many species of birds and mammals belonging to the great interior deserts of the United States and the plateau of Mexico, while their southern base and adjacent slopes form the northern limit of various tropical species.

"It was observed also that whenever the route led to the north or south of this belt the pocket gophers became rapidly less numerous, and ceased entirely except in a few places.

"By far the greater number of species now known from Mexico are absolutely restricted to limited areas within this district, while others push out only a little beyond.

"The animals, as a group, are generally found in rather loose soil and avoid stony areas. In some cases, as with *G. fumosus*, the soil may be a tough clay, but this is exceptional. Wherever found in cultivated districts they invade fields, and frequently commit serious damage to crops of both grains and tubers. It is a common practice for the land-owners to pay a fixed bounty to their field hands for them. The owner of a hacienda near Atlisco, Puebla, told me he had thus paid for seventy dozen on his hacienda in a single year, at the rate of 6 cents a head."

The most interesting and unexpected result of Mr. Nelson's explorations is the knowledge that the family *Geomyidæ* attains its highest development in a belt about 400 miles in length by 60 in breadth which crosses Mexico from west to east along the southern edge of the tableland. Within this belt Mr. Nelson collected 175 specimens, not counting the genus *Thomomys*. These specimens belong to six different genera and represent 15 species, no less than 12 of which were previously unknown.*

WEIGHT OF CHARACTERS.

Nothing is more difficult, in entering upon the study of a new group, than to determine the relative weight of characters. Structures of known stability in one group may be highly variable in another, so that characters that are of generic value in the one may be of only specific value in the other. In framing genera and higher groups therefore it is desirable to select deep-seated structures and those that are not easily affected by external influences. In the case of the skull, it is convenient to divide the characters into two categories, fundamental or primary, and superficial or secondary. *Fundamental* characters are based on structures and relations that enter into the ground plan of the skull, and are of high morphologic weight; *superficial* characters are the result of special adaptations and particular muscular strains, and are of little value except as affording recognition marks for species, and in some instances for genera also. The fundamental structures are mostly hidden, comprising the floor of the brain case, the craniofacial axis, and the turbinated bones. They are seen to best advantage in vertical longitudinal sections and in skulls from which the vault of the cranium has been removed. On the outside of the skull the palatopterygoid plates, and perhaps the frontals also, may be regarded as belonging to the same category. The superficial structures are those that appear on the outer side of the cranium and are most easily modified by muscular strain, or are the secondary result of dental peculiarities. They comprise the zygomatic arches, muzzle, nasals, occiput, and such parts of

* Since the above note was written—in fact just as this paper is going to press—Mr. Nelson has sent me 15 specimens of large gophers from the State of Oaxaca, in extreme southern Mexico. Ten of these, from Cerro San Felipe, are the species recently described by Mr. Oldfield Thomas as *Geomys scalops*; the remaining 5 are a new species, *Orthogeomys nelsoni*. They were collected at three localities: Mount Zempoaltepec, Totontepec, and Comaltepec. All of the specimens from the State of Oaxaca belong to a genus (here named *Orthogeomys*) quite distinct from any of the genera inhabiting Mr. Nelson's Geomys belt.

the outside of the vault of the cranium as are materially altered in form and extent (as the squamosals) without sensibly changing their relations on the inner side of the brain case.

LIST OF SPECIMENS EXAMINED.

Geomys tuza (Ord)	32
tuza floridanus (Aud. and Bach.)	25
tuza mobilensis subsp. nov	23
bursarius (Shaw)	116
lutescens Merriam	136
breviceps Baird	195
breviceps sagittalis subsp. nov	26
breviceps attwateri subsp. nov	53
texensis sp. nov	31
arenarius sp. nov	43
personatus True	33
personatus fallax subsp. nov	22
Pappogeomys bulleri (Thomas)	6
albinasus sp. nov	1
Cratogeomys merriami (Thomas)	31
perotensis sp. nov	13
estor sp. nov	10
peregrinus sp. nov	1
oreocetes sp. nov	1
Cratogeomys castanops (Baird)	43
castanops goldmani subsp. nov	5
fulvescens sp. nov	11
Platygeomys gymnurus Merriam	10
tylorhinus sp. nov	9
planiceps sp. nov	3
fumosus Merriam	11
Orthogeomys scalops (Thomas)	13
nelsoni sp. nov	5
latifrons sp. nov	1
Heterogeomys hispidus (Le Conte)	9
torridus sp. nov	27
Macrogeomys heterodus (Peters)	1
dolichocephalus sp. nov	2
costaricensis sp. nov	1
cherriei (Allen)	1
Zygogeomys trichopus sp. nov	12

CHAPTER II.

MORPHOLOGY OF THE SKULL.

1. THE CRANIUM AS A WHOLE.

While diversity prevails in the form of the cranium as a whole and in a multitude of minor details, all the members of the family *Geomyidæ* agree in the following important characters: The top of the skull is flattened, the nasals, frontals, and parietals usually forming nearly a straight line (though the line is decidedly convex in *Cratogeomys castanops* and *fulvescens*). The *tympanic* or audital bullæ are rather large, and the external meatus is a long tube directed forward as well as outward, and opening externally immediately behind the posterior angle of the zygoma. There is a well-developed *mastoid bulla* which is wholly on the occipital plane, never reaching the top of the skull. The *squamosals* are largely developed, always overlapping the lower part of the parietals and hinder part of the frontals, and sending out posteriorly a lateral arm which enters into the occipital plane and overreaches the mastoid process of the mastoid bulla. They articulate broadly with the alisphenoid, but leave a long slit-like vacuity between the postero-inferior margin and the audital bulla. The *basisphenoid* and *presphenoid* are higher than broad. The former develops air cells in its body; the latter is a thin vertical plate always perforate anteriorly opposite the sphenoidal fissure, so that in viewing the skull from the side one sees completely through it below the orbitosphenoids. The *alisphenoids* are larger and reach, or nearly reach, the upper surface of the cranium; they are inseparably ankylosed to the basisphenoid before birth. The *orbitosphenoids* are small and horizontal and are not united to the alisphenoids except in *Zygogeomys* and *Thomomys*. The *turbinated bones*, while presenting important differences in the several genera, agree in the following particulars: Anteriorly there is a single *maxillo-turbinal*, always attached to the premaxilla; above and parallel to it is a large *naso-turbinal*, always attached to the nasal; posteriorly, and attached to the cribriform plate and os planum are the *endoturbinals* (of Harrison Allen), always four in number and always decreasing in size from above downward; the uppermost is expanded anteriorly.

The *bony palate* is long and narrow, broader posteriorly than anteriorly, and composed chiefly of the *maxilla*, the body of the *palatine* being relatively small and situated far back. There is a deep pit on each side of the palate between the hindermost molars. Posterior to this pit the palatines usually bifurcate and unite with the pterygoids to form a lingulate or strap-shaped *palatopterygoid plate* on each side of the posterior nares. On the outside of the skull the palatines are restricted to the posterior end of the bony palate, but on the inside they reach forward along the crano facial axis all the way to the nasal chamber—a wholly unnecessary condition so far as the present structure and needs of the animal are concerned, but a highly interesting and significant relic of the primitive relations of these bones. The case is an excellent illustration of the persistence of useless parts.

The *premaxilla* is large and heavy, subquadrate in section, and articulates rather broadly with the frontal. It completely incloses the small incisive foramina except in *Zygogeomys*.

The *jugal* is a highly variable bone (as will be seen hereafter), but it is always restricted to the horizontal part of the zygoma, never creeping upward anteriorly toward the lachrymal, or inward posteriorly toward the glenoid fossa.

The *vomer* bifurcates and sends backward two long vertical wings, which articulate with the sides of the presphenoid, never with its inferior surface.

The *zygomatic arch* varies exceedingly in size and form in the different subgenera, but its horizontal part in transverse section is always distinctly triangular anteriorly, while posteriorly it is flat or rounded. Posteriorly it presents two faces, inner and outer; anteriorly a third is added—a supero-external face. The latter rarely reaches further backward than the middle of the arch and is usually set off from the outer face by a well-defined ridge, which passes obliquely backward and upward from the antero-external angle to the tip of the squamosal arm. This ridge marks the upper limit of attachment of the zygomatic part of the masseter muscle.

There is no true *postorbital process of the frontal* except in *Macrogeomys*, but the apex of the alisphenoid and adjoining anterior border of the squamosal commonly unite to form a decided *postorbital ridge*, which slopes obliquely downward and backward from the point where the frontal, alisphenoid, and squamosal meet, just behind the orbit. This ridge is made up of the edges of the alisphenoid and squamosal, and serves to sharply separate the orbit from the adjoining outer side of the brain case. In *Macrogeomys* there is a strongly developed circumscribed postorbital process, which, with the help of a corresponding eminence on the middle of the horizontal part of the zygoma, serves to sharply distinguish the orbital from the temporal fossa. In its component elements it is peculiar. Its base consists of the frontal, which bone is notched immediately in front of it, thus emphasizing the apparent size of the process. The summit of the process is made up of the apex of the alisphenoid, which here reaches the plane of the upper part of the skull and is slightly overlapped posteriorly by the antero-external angle of the squamosal.

The *paroccipital processes* stand out sideways above the condyles and are more or less expanded and flattened—never cylindrical or conical (figs. 4 and 55 *pp*. and pl. 15, figs. 6 and 7).

The *floor of the brain case*, as exposed by sawing off the vault of the cranium, affords characters of the utmost value in subdividing the group into genera (figs. 9, 56, and 68[3], and pl. 17). As will be seen on consulting fig. 9, the tympano-periotic capsules, with the inclosed basioccipital and posterior part of the basisphenoid, form about half of the floor of the brain case. The alisphenoids (fig. 9, *as*) are next in importance, the horizontal part forming a bridge across the floor of the skull above the pterygoid fossæ and immediately in front of the tympanic bullæ, while the ascending wings push forward on each side, reaching or nearly reaching the orbitosphenoids (*os*), and forming the posterior and outer boundaries of the large sphenoid fossa. Anteriorly the orbitosphenoids fill or nearly fill the front part of the floor of the brain case, on the plane of the orbital constriction. In front of this constriction, and behind the cribriform plate, the orbital or descending plates of the frontal commonly meet in the median line, forming the floor of the olfactory fossa. In young skulls, as in fig. 9, and in adults of the genera *Pappogeomys* (fig. 56), *Orthogeomys*, and *Thomomys* (fig. 68[3]), the frontals do not meet below, but the orbitosphenoids reach forward and articulate directly with the cribriform plate.

A conspicuous and highly important pair of fossæ occupy the anterior part of the floor of the brain case on each side of the median line, where they are completely surrounded by the several sphenoid bones. They may be termed the *sphenoid fossæ*. They are directly continuous and inseparably connected posteriorly with the *pterygoid fossæ* proper, which latter are widely open in front and are roofed over by the transverse part of the alisphenoid only. The resulting elongated fossa as a whole may be named the *spheno-pterygoid fossa* (fig. 9, *ptf*). The shape and extent of the sphenoid fossa varies materially in the different genera, as shown in pl. 17: in *Geomys* (fig. 3) and *Heterogeomys* (fig. 1) it is much elongated, reaching anteriorly to the descending plate of the frontal. In *Cratogeomys* (fig. 9, pl. 17, and fig. 5), and also in *Pappogeomys* (fig. 56) and *Orthogeomys*, it is cut off anteriorly by the orbitosphenoids. In *Zygogeomys* (pl. 17, fig. 2) it is still further shortened by the posterior enlargement of the orbitosphenoids, which are broadly ankylosed with the alisphenoids.

The anterior end of the alisphenoid canal (fig. 9, *ac*) always opens into the outer side of the posterior part of the sphenoid fossa, and its position is essentially the same throughout the family (see pl. 17, and text figs. 9 *ac*, 52 and 54 *alc*, 56, and 68).

The *pterygoid fossæ* are large and widely open (fig. 12, *ptf*). Posteriorly they are bridged by the narrow horizontal arm of the alisphenoid (fig. 9, *as*); anteriorly they are not closed or roofed over, but are broadly continuous with the large and deep sphenoid fossæ (fig. 9, *ptf*), which open into the orbit by means of the broadly expanded lower part of the sphenoidal fissure. Their floor consists posteriorly of palatine and anteriorly of maxillary. On the inner side they are bounded by the pterygoid, the vertical plate of the palatine, the basisphenoid, and the presphenoid. On the outer side they are bounded inferiorly by the external pterygoid plate of the palatine (fig. 12, *epl*), and superiorly by the descending wing of the alisphenoid. The outer wall of the posterior part of the pterygoid fossa thus proves to be double, and the inner bone—*the external pterygoid plate*—belongs to the palatine and is overlapped by the descending wing of the alisphenoid, as shown in figs. 4 and 12.

The *sphenoidal fissure* is a large and nearly vertical pyriform vacuity at the bottom of the orbit, separating the anterior border of the alisphenoid from the descending or orbital plate of the frontal (fig. 55[a]). It separates also, to a varying degree, the alisphenoid from the orbitosphenoid (fig. 9, *sf*). Superiorly (above the horizontal plane of the orbitosphenoids) it is a narrow slit sloping obliquely upward and forward between the brain case proper and the olfactory fossa, and ending at the base of the thickened interorbital constriction of the frontal (which continues the line of separation between the olfactory fossa and cerebral chamber). This slit is permanently open except in *Zygogeomys* (in which it is closed by the orbitosphenoid), looking completely through the skull from side to side. Inferiorly (below the horizontal plane of the orbitosphenoids) the fissure is suddenly dilated, forming a broad and widely open door between the deep lateral fossa of the floor of the brain case and the bottom of the orbit. The corresponding basal parts of the fissure on the two sides of the skull are incompletely separated by a perforate septum consisting of the vertical plate of the presphenoid, and in some cases of an ascending wing of the palatine also. The sphenoidal fissure is bounded by three bones: posteriorly by the ali-

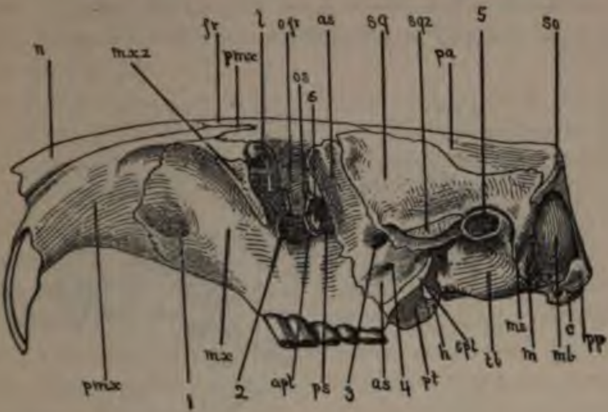


FIG. 4.—Side view of skull of *Cratogeomys merriami* from the outside. Zygomatic arch sawed off to show bottom of orbit. Animal not quite adult. Specimen from Amecameca, Valley of Mexico. (This figure should be compared with the corresponding view of *Geomys bursarius*, fig. 55.)

1 Infraorbital foramen.
2 Posterior (orbital) opening of infraorbital canal.
3 Foramen rotundum.
4 Foramen ovale.
5 Meatus auditorius externus.
6 Fenestrum in anterior part of presphenoid (the line pointing to it crosses the upper part of the sphenoidal fissure).
apl Ascending wing of vertical plate of palatine.
as Alisphenoid (the upper line rests on the ascending wing; the lower on the descending wing).
c Condyle of exoccipital.
epl External pterygoid plate of palatine bone.
fr Frontal.
h Hamular process of pterygoid bone.
l Lachrymal.
m Mastoid process of mastoid bulla.
mb Mastoid bulla.
ms Mastoid process of squamosal.
mx Maxilla.
mxz Zygomatic root of maxilla (sawed off to show orbit).
n Nasal.
ofr Orbital or descending plate of frontal.
os Orbitosphenoid.
pa Parietal.
pmx Premaxilla.
pp Paroccipital process of exoccipital.
ps Presphenoid.
pt Pterygoid.
so Supraoccipital.
sq Squamosal.
sqz Squamosal root of zygoma (sawed off).
tb Tympanic or audital bulla.

sphenoid; anteriorly by the frontal and maxilla; and inferiorly by the maxilla. The longitudinal vertical septum which forms the floor of the large inferior part of the sphenoidal fissure is likewise made up of three bones, the orbitosphenoid, presphenoid, and palatine—though the latter is usually so reduced that it appears in the antero-inferior corner only, and in some forms can not be seen from the outside at all. But in the elongated skulls of *Geomys bursarius* and *tuza* the lower part of the fissure is broadened antero-posteriorly, and the ascending wing of

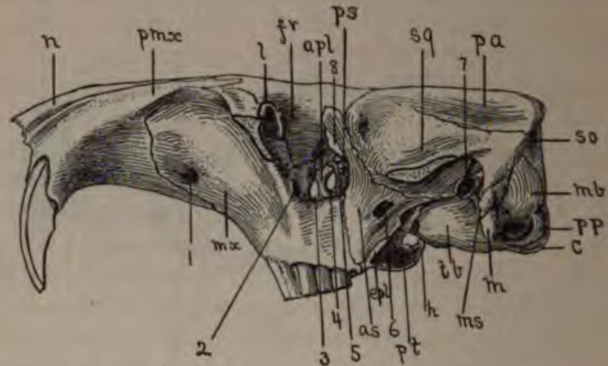


FIG. 55.—Side view of skull of *Geomys bursarius* from outside, zygomatic arch sawed off to show bottom of orbit. Animal fully adult ♂. From Knoxville, Iowa. (This figure is duplicated for easy comparison with the corresponding view of *Cratogeomys merriami*, fig. 4).

1. Infraorbital foramen.
2. Posterior (orbital) opening of infraorbital canal.
3. Vacuity in front of presphenoid and ascending wing of palatine.
4. Vacuity in presphenoid, behind ascending wing of palatine.
5. Optic foramen (in orbitosphenoid bone).
6. Foramen rotundum and foramen ovale (which have here coalesced).
7. External auditory meatus.
8. Sphenoidal fissure (upper part).

apl. Ascending wing of vertical plate of palatine.
as. Alisphenoid.
c. Condyle of exoccipital.
epl. External pterygoid plate of palatine bone.
fr. Frontal.
h. Hamular process of pterygoid bone.
l. Lachrymal.
m. Mastoid process of mastoid bulla.
mb. Mastoid bulla.
ms. Mastoid process of squamosal.
mx. Maxilla.
n. Nasal.
pa. Parietal.
pmx. Premaxilla.
pp. Paroccipital process of exoccipital.
ps. Presphenoid.
pt. Pterygoid.
so. Supraoccipital.
sq. Squamosal.
tb. Tympanic or audital bulla.

the palatine is enlarged and extended, reaching upward alongside the presphenoid (in front of the usual fenestrum) to articulate broadly with the frontal and orbitosphenoid, on or near the plane of the top of the presphenoid (fig. 55). In front of the palatine (and also in front of the presphenoid, which is here clasped between the ascending wings of the palatine on the two sides of the skull) is a second fenestrum (fig. 55[3]) anterior to the usual one (fig. 55[4], which is in the presphenoid), and likewise looking completely through the skull. This latter opening is bounded in front by the maxilla and behind by the palatine. It is situated midway between the sphenoid fenestrum and the orbital end of the infraorbital canal.

The *infraorbital canal* is small and does not pierce the root of the zygoma, but is deeply buried in the maxillary bone, passing backward and inward from the infraorbital foramen (fig. 4[1]) (on the lower part of the side of the muzzle just behind the premaxillary suture) to the deepest part of the orbit (fig. 4[2]), its course being wholly internal to the zygomatic root of the maxillary. It curves around the inner side of the base of the socket of the long upper incisor, and is separated from the nasal chamber by only a thin lamella of bone rising from the maxillary floor of the nasal passage and articulating above with the inferior border of that part of the os planum which supports the endoturbinals.

The *foramen rotundum* (fig. 4[3]) is always situated above the *foramen ovale* (fig. 4[4]), and both open into the large longitudinal alisphenoid canal. In rare instances they coalesce (fig. 55[6]).

The *narial passage* is a narrow vertical ellipse, about twice as high as broad (fig. 7, *np*).

While most species of the genera under consideration develop a prominent *sagittal crest* in adult life, some do not, the temporal impressions remaining permanently distant, defining a well-marked *sagittal area*. The members of the latter category may be divided into two sets, (1) those in which the temporal impressions are actual ridges rising above the level of the surrounding bone on both sides, as in *Heterogeomys hispidus* (pl. 4), *Geomys tuza* (pl. 7, fig. 1), and *G. arenarius* (pl. 9, fig. 1); and (2) those in which the space between the temporal impressions (the *sagittal area*) is thickened and as high as the impressions, which thus appear as ridges only when looked at from the outer side, as in *Geomys breviceps* (pl. 9, fig. 6) and *Cratogeomys oreocetes* and *peregrinus* (pl. 8, figs. 2 and 3).

The *lambdoid crest* is broadly and gently convex posteriorly throughout the group (pls. 1, 2, 5–9, etc.), except in *Platygeomys*, in which genus (pl. 3 and pl. 11, fig. 4) it is strongly sinuous—forming a deep and broad reentrant angle on the median line, beyond which, on each side, it is first strongly convex backward and then slightly convex forward—the extreme mastoid ends curving backward as well as outward. The bones that take part in the formation of the lambdoid crest are the supraoccipital, squamosals, parietals, and interparietal.

There is no ossified tentorium in the *Geomyidæ*.

2. THE INDIVIDUAL BONES.

In the *Geomyidæ* there are normally thirty-three distinct bones in the skull, not counting the separate parts of the tympano-periotic capsule, the turbinated bones of the nasal chamber (which are reckoned with the bones to which they are attached) or the paired bones that coalesce before birth. The latter are the premaxillæ, maxillæ, palatines, and frontals.

The thirty-three bones that go to make up the skull (exclusive of the paired bones that are fused in the embryo) are:

Basioccipital	1	Vomer	1
Exoccipital	2	Pterygoid	2
Supraoccipital	1	Palatine	1
Interparietal	1	Maxilla	1
Basisphenoid	1	Premaxilla	1
Alisphenoid	2	Lachrymal	2
Squamosal	2	Jugal	2
Parietal	2	Nasal	2
Presphenoid	1	Periotic	2
Orbitosphenoid	2	Mandible	2
Frontal	1		—
Ethmoid	1		33

The *basioccipital* is commonly truncate-wedge-shaped, with the posterior edge (*basion*) rather deeply notched. Its posterior corners enter

FIG. 5.—Basioccipital of *Cratogeomys merriami*, showing difference in form of upper and lower surfaces (ankylosed exoccipitals shown also): *a*, inferior surface; *b*, superior surface; *pp*, paroccipital process.

very slightly into the formation of the occipital condyles. The inferior surface of the body of the basioccipital is normally broader posteriorly than anteriorly and the decrease in breadth from behind forward is gradual (pl. 12, fig. 2, *a*); but in one species, *Cratogeomys castanops*, the body of the bone is rectangular, its sides being parallel (pl. 12, fig. 1, *a*). In another, *Orthogeomys scalops*, they may be nearly parallel or even slightly divergent anteriorly (pl. 19, fig. 2). The basioccipital varies in breadth according to the development of the audital bullæ, by which its sides are always more or less excavated. Its outer borders are usually grooved to receive a projection from the bulla. The superior surface (on floor of brain case) is always narrower than the inferior surface. The difference is very marked in some species (see fig. 5, *a* and *b*). The basioccipital early ankyloses with the exoccipitals,* but usually

* The exoccipitals coössify with the basioccipital very early in *Zygogeomys* and *Geomys* proper; somewhat later in *Cratogeomys*, *Platygeomys*, and *Heterogeomys*.

remains distinct from the basisphenoid, with which it unites by synchondrosis.

The *exoccipitals* form the whole of the condyles except the extreme lower ends, into which the outer corners of the basioccipital enter. They early ankylose with the basioccipital, forming a single bone long before the animal becomes adult. No part of the exoccipital ever projects downward below the plane of the condyles. The paroccipital processes stand out sideways and impinge upon the base of the mastoid bulla immediately behind the audital bulla; they are commonly more or less flattened and expanded, and their distal ends often project backward (fig. 12, *pp*). In *Platygeomys* they attain their maximum development and form the lateral parieties of a deep basin-shaped depression, the upper boundary of which is formed by the backward projecting lambdoid crest (pl. 15, fig. 7). The exoccipitals are in contact anteriorly with the mastoid bullæ and periotic capsules, which they partly overlap. Viewed from behind, they form the inner boundary of the exposed part of the mastoid bullæ. Vertically they reach the upper edge of the foramen magnum, and their upper border forms nearly a straight line across the plane of the occiput.

The *supraoccipital* forms a small part of the roof of the brain case and the greater part of the occipital plane, comprising all of the occipital element above the foramen magnum. On the top of the skull it reaches much farther forward in *Platygeomys* than in the other genera, (fig. 53, *so*), but is usually nearly concealed in adult life by being overlapped by the parietal and squamosal. On the occipital plane its inferior border forms the superior boundary of the foramen magnum; its outer sides curve around the basal part of the exposed mastoid bullæ, though rarely reaching laterally as far as the free ends of the mastoids. Anteriorly the supraoccipital articulates with the squamosals and parietals, and with the interparietal also in those cases in which the latter bone has an independent existence. [As a rule the interparietal is not separate from the supraoccipital.]

The *interparietal*, which has proved of considerable importance in furnishing specific characters in the *Heteromyidæ*, is small and of little consequence in most species of *Geomyidæ*, except in the single genus *Thomomys*. Even in very early life it forms an inseparable part of the supraocciptial in the *castanops* series of *Cratogeomys*, in *Platygeomys gymnurus*, in the *bursarius* series of *Geomys* proper, and in *Pappogeomys*, *Heterogeomys*, and *Zygogeomys*. It is distinct all around in early life in most species of *Thomomys*, in the *merriami* series of *Cratogeomys*, in the *tuza* series of *Geomys* proper, in *Geomys texensis* and *breviceps*, in *Platygeomys tylorhinus* and *planiceps*, but not in *P. gymnurus*. From its variability in closely related species it is evidently of little importance for purposes of classification, though its value in *Thomomys* is much greater than in any of the other genera; and it is of some value in the restricted genus *Geomys* also. In the young it is commonly subquadrate or broadly oval and of relatively large size, but with advancing age it becomes smaller and narrowly triangular or wedge-shaped, its outer borders being resorbed from pressure of the parietals, which are constantly crowding toward the median line. Thus in *Platygeomys tylorhinus* several skulls from the same locality (Tula, Hidalgo, Mexico) present the following variations in the interparietal:

FIG. 6.—Forms of interparietal. *a, b, c, d, Platygeomys tylorhinus* showing changes with age. *e. Geomys tuza* ♂ ad. Augusta, Ga. *f* and *g G. mobilensis:* ♂ *f* yg. ad.; *g* ♂ ad. Milton, Fla. All natural size.

A very young male (fig. 6, *a*, No. 51882) has it roughly subquadrate and broader than long; an immature but older female (fig. 6*b*, No. 51884) has it of the same shape, but narrower and longer than broad; a still older specimen (fig. No. 6, *c*) has it broadly triangular; while an adult (fig. 6, *d*, No. 51883, ♂) has it reduced to a small wedge-shaped piece squeezed in between the hinder edges of the parietals.

In the young of *Zygogeomys trichopus* the interparietal is even larger than in *Platygeomys tylorhinus*, and is about twice as broad as long (measuring 8 mm. in breadth in No. 50104 juv. fig. 15, *a*). In shape it is broadly convex anteriorily and slightly (flatly) convex posteriorly. The progressive development of the powerful temporal muscles with consequent enlargement of the parietals posteriorly encroach upon its size and change its shape, pressing it into an equilateral triangle (as in No. 47186 ♂ im., fig. 15, *b*). Its size now decreases rapidly, and as the temporal impressions meet in a well-developed sagittal crest in the adult skull it nearly or quite disappears from the upper surface of the cranium (as in No. 50100 ♂ ad., fig. 15, *c*).

The interparietal is more stable in form in several of the species of the restricted genus *Geomys* than in any of the other genera under consideration. This is due chiefly to the circumstance that in this genus several species have permanently distant temporal impressions—for nothing is so destructive to an interparietal as the development of a sagittal crest. In the species possessing a crest (*bursarius, lutescens, personatus, fallax*, and *mobilensis*) the interparietal is normally reduced in adult life to an inconspicuous subtriangular wedge. In the species having a permanent sagittal area it remains of considerable size and its form is reasonably constant. In *G. arenarius* it is normally subquadrate, though the anterior border may become convex from rounding off of the corners, and it is always truncate behind and persists in old age (pl. 9, fig. 1). In *G. texensis* it is normally elliptical or oval (broader than long) and convex posteriorly as well as anteriorly, projecting nearly as far behind as in front of the lambdoid suture (pl. 9, fig. 2). In *G. breviceps* it is usually reduced to a highly irregular 'wormian' bone, much cut up by contortions of the sutures (pl. 9, fig. 6). In *G. tuza* it is very large, occupying nearly half of the broad sagittal area, and is convex in front, truncate behind (fig. 6*e*). In the closely related *G. mobilensis* it is deeply notched behind and is encroached upon and finally nearly obliterated by the union of the temporal ridges (fig. 6, *f* and *g*).

The *basisphenoid* is invariably ankylosed with the alisphenoids and pterygoids, even in early life, and sooner or later usually coossifies with the presphenoid; it commonly, though not always, remains distinct from the basioccipital. Its vertical height is generally greater than its breadth, and air cells commonly develop in its substance (fig. 7, *bs*). Its chief peculiarity is the slight development of the pituitary fossa, which ordinarily is so shallow as to escape notice. But in *Heterogeomys* it is a real depression, and in *H. hispidus* it is normally a pit and completely perforates the bone. In the related species, *H. torridus*, it is much less conspicuous and never perforates (so far as the series of 26 skulls goes).

The basisphenoid articulates with the basioccipital, presphenoid, alisphenoids (by ankylosis), pterygoids (by ankylosis), and vertical plates of the palatines (by contact antero-inferiorly—see fig. 7).

The *alisphenoid* is a very important bone, serving to bind firmly together the middle segment of the vault of the cranium with the posterior part of the upper jaw, and to anchor both securely to the basicranial axis. It may be described as consisting of three parts, (1) a *horizontal* or *transverse* part, (2) an *ascending wing*, and (3) a *descending wing*.

(1) The *transverse* or horizontal part is little more than a narrow bar, inseparably connected with the middle of the outer side of the basisphenoid (figs. 9, *as* and 54, *alh*); it forms the floor of the brain case immediately in front of the periotic, and the roof of the posterior part of the pterygoid fossa, the anterior part being uncovered. In passing outward it bifurcates to inclose the large longitudinal alisphenoid canal, above which it becomes continuous with the ascending wing, and below with the descending wing. Posteriorly, the base of the horizontal part of the alisphenoid is excavated, and usually presents a cup-shaped enlargement to receive the apex of the audital bulla. It also descends alongside the basioccipital to unite with the pterygoid posteriorly.

(2) The *ascending wing* of the *alisphenoid* differs widely in form as viewed from the inside or outside of the brain case. On the outer side of the skull (fig. 4, *as*) it is a long rectangular blade ascending obliquely in front of the squamosal, with the anterior border of which it articulates. It also overlaps the posterior part of the orbital face of the frontal, rising nearly to the upper surface of the skull, which it sometimes reaches. The upper part is always roughened, and, with the overlapping edge of the squamosal, forms an oblique postorbital ridge or prominence. Sometimes the apex pushes up to the top of the skull, where it is thickened and forms the major part of a distinct *postorbital process*, resting on the frontal, and overlapped posteriorly by the antero-external corner of the squamosal. This process attains its highest development in *Macrogeomys* (see pl. 11, fig. 2, and text fig. 17[3]). Posteriorly the ascending wing is extensively overlapped by the squamosal,

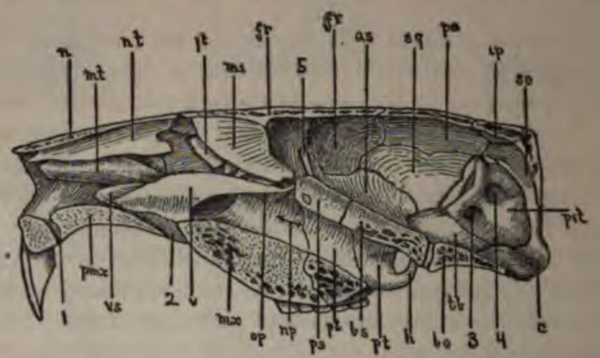


FIG. 7.—Longitudinal vertical median section of skull of *Orthogeomys merriami*, showing interior of brain case and nasal chamber. Vomer and mesethmoid in place.

1 Anterior palatine foramen.
2 Incisive foramen.
3 Meatus auditorius internus.
4 Floccular fossa.
5 Upper part of sphenoidal fissure.
as Alisphenoid.
bo Basioccipital.
bs Basisphenoid.
c Condyle of exoccipital.
fr Frontal.
h Hamular process of pterygoid.
ip Interparietal.
me Mesethmoid plate.
mt Maxillo-turbinal.
mx Maxilla.
n Nasal.
nt Naso-turbinal.
op Lower border of os planum.
pa Parietal.
pet Petrous part of periotic capsule.
pl Palatine.
pmx Premaxilla.
ps Presphenoid.
pt Pterygoid.
so Supraoccipital.
sq Squamosal.
tb Tympanic bulla (antero-superior part, which alone appears within the brain case).
v Vomer.
vs Vomerine sheath of maxilla.
1t First endoturbinal (below and somewhat behind it the anterior ends of the second, third, and fourth endoturbinals may be seen).

as appears when examined from the inner side of the brain case (fig. 7, *as*). Therefore, while the outer face is an obliquely-vertical plate, with essentially parallel sides, the inner face is elongated horizontally, with an irregularly convex upper border—the difference being due to the fact that the outer side overlaps the frontal anteriorly and is overlapped by the squamosal posteriorly. The alisphenoid may be separated from the orbitosphenoid as in *Heterogeomys* and *Geomys* (pl. 17, figs. 1 and 3), or the two bones may be in contact anteriorly as in *Cratogeomys* (pl. 17, fig. 5, and text fig. 9), or they may be firmly and broadly ankylosed together as in *Zygogeomys* (pl. 17, fig. 2).

(3) The *descending wing* of the *alisphenoid*, on the outer side of the skull, is a flattened plate continuous in breadth, plane, and direction with the ascending wing, and passing obliquely downward and backward between the posterior border of the maxilla and the antero-inferior edge of the squamosal (fig. 4, *as*, lower pointer). Anteriorly it forms the outer wall of the pterygoid fossa; posteriorly it overlaps the external pterygoid plate of the palatine. It articulates with the maxilla, palatine, and squamosal; and is pierced by two foramina, the *foramen rotundum* and the *foramen ovale*, which, in rare cases, merge into one. The *foramen rotundum* (fig. 4[3]) is very much larger than the *foramen ovale*, and is situated immediately below the anterior end of the squamosal root of the zygoma. It opens into the anterior part of the large alisphenoid canal, and sometimes also directly into the deep sphenoid fossa of the floor of the brain case. In *Geomys* proper it is higher up than usual and consequently opens downward into the alisphenoid canal. The *foramen ovale* (fig. 4[1]) is a small slit-like opening beneath the *foramen rotundum;* it opens obliquely upward (and usually backward) into the lower part of the alisphenoid canal. The *foramen ovale* presents considerable variation in its position and relations, affording characters of some value in separating the genera. In *Cratogeomys* it is near the anterior border of the lower part of the alisphenoid, directly beneath the *foramen rotundum* and far below the alisphenoid canal, which it reaches posteriorly by an obliquely upward and backward course. In *Platygeomys* and *Heterogeomys* it is similarly situated, except that it is nearer the middle than the anterior border of the descending wing of the alisphenoid, and is decidedly nearer the alisphenoid canal and *foramen rotundum*. In *Heterogeomys* it is not infrequently confluent on one side with the *foramen rotundum*. In *Platygeomys* it is somewhat posterior to the *foramen rotundum* and nearer it than in *Heterogeomys*. In *Zygogeomys* it is immediately below and close to the *foramen rotundum* and sometimes confluent with it; it is high up and opens *directly* into the alisphenoid canal. In *Geomys* proper it is high up also, and often becomes confluent with the *foramen rotundum* (as in fig. 55[6]). In the *tuza* series its size is unusually small.

The alisphenoid as a whole articulates with the frontal, squamosal, maxilla, palatine, basisphenoid, pterygoid, tympanic capsule, and in some genera with the orbitosphenoid also.

The *squamosal* is a large and highly important bone in the *Geomyidæ* (figs. 4, 7, 8, and 9, *sq*). It overlaps to a considerable extent the other bones of the parieties of the brain case, imparting great power of resistance to the vault of the cranium. Antero-inferiorly it articulates with the alisphenoid for its entire length. Postero-inferiorly a long slit-like vacuity separates it from the audital bulla, though in some cases it is in contact with parts of the bulla. Posteriorly it overspreads the superior face of the outer part of the supraoccipital and the mastoid bulla and sends a lateral arm out sideways (the mastoid arm), which overreaches and articulates with the end of the mastoid process of the mastoid bulla. Superiorly it covers the posterior part of the frontals and broadly overlaps the parietals for their entire length—actually concealing them in one species, *Cratogeomys merriami*. The squamosal gives off the posterior root of the zygoma and articulates with the jugal. In *Zygogeomys trichopus* and *Macrogeomys costaricensis*, owing to the much-reduced size of the jugal, the squamosal arm reaches far forward and articulates directly with the maxilla—a most exceptional condition among mammals. Below the squamosal root of the zygoma is the elongated and ill-defined *glenoid fossa*, which is completed posteriorly and on the inner side by the tympanic bulla. The

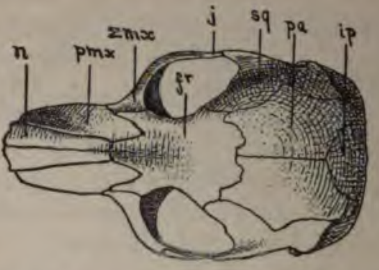


FIG. 8.—Skull of very young *Geomys bursarius* from Elk River, Minnesota. Upper surface, showing frontals ankylosed together, and interparietal inseparable from supraoccipital at birth.

fr, frontal; *ip*, interparietal; *j*, jugal; *n*, nasal; *pa*, parietal; *pmx*, ascending branch of premaxilla; *sq*, squamosal; *zmx*, maxillary root of zygoma.

form of the postglenoid notch varies from broadly U-shaped in *Platygeomys* and some others to narrowly V-shaped in *Geomys bursarius*. In *Platygeomys* and *Cratogeomys* the glenoid fossa is produced anteriorly a long distance in front of the squamosal root of the zygoma.

The mastoid arm of the squamosal enters the outer part of the occipital plane above the mastoid bulla and external to the supraoccipital, where it forms the whole thickness of the lambdoid crest (see pl. 15, figs. 3, 4, 6, and 7). In *Heterogeomys* it is vertically expanded, taking a more prominent part than usual in the occiput. The variations in the squamosal are described later (pp. 66–67).

The *parietals* complete the roof of the brain case posteriorly (fig. 8, *pa*). They do not present any unusual variations in the *Geomyidæ*; they overlap the frontal anteriorly and the supraoccipital and interparietal posteriorly, and are overlapped for their full length inferiorly by the squamosals, which in *Cratogeomys merriami* gradually overspread and conceal them. The parietals are always separate in early life, but usually coalesce in the adult. The temporal impressions may remain permanently distant, defining a sagittal area, or they may unite in a prominent sagittal crest.

The *presphenoid* is a thin vertical plate of bone bridging the gap between the basisphenoid and mesethmoid cartilage and supporting, from its superior surface, the horizontally flattened orbitosphenoids (figs. 4, 7, and 9, *ps**). It is perforated anteriorly by a rather large opening, which, being opposite the sphenoidal fissure, enables one to see completely through the skull at this point (figs. 46, 10[4], and 55[4]). A second fenestrum often exists behind the first, and in *Orthogeomys* one or two small perforations usually occur in front of it. Superiorly the presphenoid supports the orbitosphenoids (fig. 9, *os*), with which it is

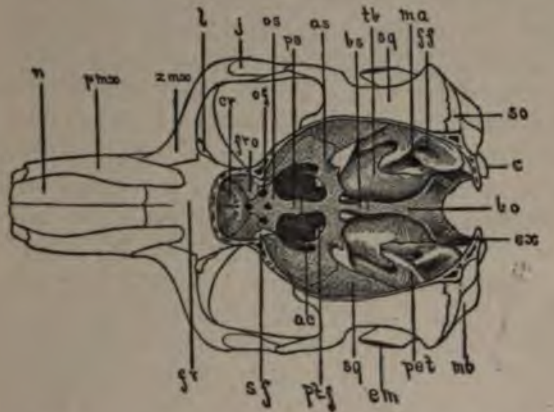


FIG. 9.—Young skull of *Cratogeomys merriami* from Amecameca, Mexico, with vault of cranium removed to show floor of brain case.

ac Anterior opening of alisphenoid canal.
as Alisphenoid bone.
bo Basioccipital.
bs Basisphenoid.
Condyle of exoccipital.
cr Cribriform plate of ethmoid.
eam External auditory meatus.
ex Exoccipital.
ff Floccular fossa.
fr Frontal.
fro Descending or orbital plate of frontal (the animal is so young that the plates of the two sides have not yet united below).
Jugal.
Lachrymal.
ma Meatus auditorius internus.
mb Mastoid bulla.
n Nasal.
of Optic foramen.
os Orbitosphenoid.
pet Petrous part of periotic.
pmx Ascending arm of premaxilla.
ps Presphenoid.
ptf Spheno-pterygoid fossa.
sf Apex of sphenoidal fissure.
so Supraoccipital.
sq Squamosal.
tb Superior face of tympanic or audital bulla.
zmx Zygomatic root of maxilla.

inseparably ankylosed; anteriorly it abuts against the mesethmoid cartilage and is in contact with the ethmoid and usually the vomer; posteriorly it abuts against the basisphenoid, with which it commonly becomes ankylosed before the animal is fully adult. The ascending

*In fig. 9, which is a young skull, the presphenoid is covered by the orbitosphenoids, making it appear very much broader than it really is.

wings (vertical plates) of the palatines clasp the sides of the presphenoid inferiorly, rising anteriorly. The ends of the vomer reach it also, clasping it laterally, but never underlying it as in many mammals. The presphenoid ends anteriorly in a somewhat thickened head, with a disk-shaped cavity in front, which receives the hinder end of the mesethmoid cartilage.

The *orbitosphenoids* are a pair of thin horizontal shelves resting upon and invariably ankylosed to the upper border of the presphenoid, and articulating anteriorly with the orbital plate of the frontal (fig. 9, *os*, and pl. 17). They are normally perforated near the anterior border by the *optic foramen* (fig. 9, *of*), but in *Heterogeomys* this foramen is incomplete superiorly (pl. 17, fig. 1) except in the young. The antero-external corner sometimes protrudes through the sphenoidal fissure, bends upward, and slightly overlaps the posterior border of the descending wing of the frontal, appearing as a small scale in the bottom of the orbit. This is most often observed in young skulls. In *Zygogeomys*, *Pappogeomys*, and some forms of *Thomomys* the ascending tongue of the orbitosphenoid completely closes the upper part of the sphenoidal fissure, except a small point at its apex, which is left as a permanent foramen (pl. 18, fig. 2), and becomes ankylosed to the frontal anteriorly and the alisphenoid posteriorly (pl. 17, fig. 2). With these exceptions it does not appear in the parieties of the cranium, though it may always be seen crossing the sphenoidal fissure, which it divides into two parts. Anteriorly the orbitosphenoid invariably articulates with the upper surface of the presphenoid and the descending wings of the frontal, as already stated, and sometimes also with the palatine, maxilla, and posterior edge of the cribriform plate; posteriorly it often touches the edge of the alisphenoid, to which it becomes fixed in *Cratogeomys*, *Orthogeomys*, *Pappogeomys*, *Zygogeomys*, and some forms of *Thomomys*.

The relations of the orbitosphenoids anteriorly vary in the several groups and in some cases are exceedingly difficult to ascertain, owing to early ankylosis with the presphenoid. In *Geomys bursarius* the ascending wings of the palatine rise high on the sides of the presphenoid and articulate broadly with the orbitosphenoids, but in most forms it is uncertain whether or not the palatine is reached. The uncertainty is due to the impossibility of determining how far the orbitosphenoid descends anteriorly below the top of the presphenoid, with which it is inseparably fused. For the same reason it is uncertain whether or not the orbitosphenoids always reach the cribriform plate of the ethmoid. They seem to do so in all cases along the median line, but I have been unable, even in very young skulls, to find the place of separation anteriorly between the orbitosphenoids and presphenoid. In those genera in which the descending or orbital plates of the frontal do not meet inferiorly behind the cribriform plate, the orbitosphenoids articulate broadly with the cribriform (as in *Pappogeomys*, *Orthogeomys*, and *Thomomys*).

In *Geomys* proper the orbitosphenoids are narrower than in any of the other genera, and do not reach the alisphenoids. In *Heterogeomys* and *Platygeomys* also they usually fall short of the alisphenoid, though in extreme cases they sometimes cross the anterior edge of the alisphenoid. In *Cratogeomys* and *Orthogeomys* they articulate with the alisphenoid anteriorly for a short distance, but do not follow the upper part of the sphenoidal fissure, though in *Orthogeomys* they sometimes send a tongue upward covering part of the fissure. In *Pappogeomys* and some species of *Thomomys* they go a step further, articulating firmly and broadly with the alisphenoid and normally closing the greater part of the sphenoidal fissure above the plane of the presphenoid. *Zygogeomys* presents a still more extreme phase, the orbitosphenoid almost completely closing the upper part of the sphenoidal fissure and ankylosing broadly with the alisphenoids. From what has been said it must be clear that the orbitosphenoids play a more important part than any other bones in determining the form of the floor of the brain case, for the reason that by their expansion or contraction anteriorly they completely change the size and shape of the sphenoid fossa, which is the most conspicuous of the variable landmarks of the floor of the brain case, as may be seen on consulting pl. 17.

The *frontals* coalesce very early (probably before birth), forming a single large bone (fig. 8, *fr*) which constitutes the middle third of the upper surface of the skull and dips deeply into the orbits, where it makes important connections with the maxilla and other bones. It forms the roof of the olfactory chamber of the nasal cavity, and the roof and part of the side walls of the anterior segment of the brain case. The main body of the frontal articulates anteriorly with the ethmoid, nasals, premaxilla, maxilla, and lachrymals, and posteriorly with the parietals, squamosals, and alisphenoids. It is so extensively overlapped by the alisphenoids and squamosals that when viewed from the outside it appears much smaller than it really is.

The descending or orbital processes of the frontal (figs. 4, *ofr*, and 9, *fro*) reach far downward, burying themselves deeply among the bones of the base of the cranium and face. They articulate with the anterior border of the orbitosphenoids, clasp the sides of the presphenoid and palatines anteriorly, and articulate firmly with the maxillaries. Anteriorly, except in *Thomomys*, *Pappogeomys* (fig. 56), and *Orthogeomys*, they completely encircle the cribriform plate of the ethmoid (with which they early unite by ankylosis) and meet in the median line below it, thus reaching around the olfactory lobes of the brain case and forming the floor as well as the roof and sides of the olfactory fossa. At the point where the two arms come together in the median line, at the posterior base of the cribriform plate, a small opening is commonly left which remains as a perforating foramen passing obliquely forward and downward between the presphenoid and mesethmoid plate, and opening anteriorly into the olfactory chamber of the nasal cavity immediately behind the lower part of the fourth endoturbinals. In *Thomomys* (fig. 61), and in the young of most of the other genera (as in *Cratogeomys*, fig. 9, *fro*), the orbital plates of the frontal are separated inferiorly by the orbitosphenoids. The variations in the form of the frontal are described further on (p. 65 and fig. 17).

The *ethmoid* is a highly complicated bone occupying the posterior part of the olfactory chamber of the nasal cavity, which it completely separates from the brain case. No part of it appears on the outside of the skull. It may be described under five heads: (1) the *cribriform plate;* (2) the *mesethmoid;* (3) the *os planum;* (4) the *ectoturbinals*, and (5) the *endoturbinals*. There is no apparent 'crista galli' in the *Geomyidæ*. [The naso- and maxillo-turbinals are completely detached, and are described under the bones to which they are respectively ankylosed, namely, the nasal and premaxilla.]

(1) The *cribriform plate* is a transverse perforated partition, separating the olfactory fossa of the brain case from the olfactory chamber of the nasal cavity (fig. 9, *cr*). It is nearly circular in outline and slopes or curves forward from the base upward. Posteriorly, in most of the genera, its entire circumference articulates (and early ankyloses) with the frontals, which usually separate it inferiorly from the orbitosphenoids, though the latter may always reach it near the median line by pushing forward beneath the frontals. To its anterior face are attached the *ectoturbinals*, *endoturbinals*, and *mesethmoid*.

(2) The *mesethmoid* bone, or perpendicular plate of the ethmoid, is a longitudinal median partition incompletely dividing the olfactory chamber into two parts (fig. 7, *me*). Its superior border is firmly and inseparably ankylosed to the frontal; its posterior to the cribriform plate. Antero-inferiorly it abuts against the cartilaginous mesethmoid, which latter reaches forward from the presphenoid and is embraced between the lateral wings of the vomer, completing the partition between the two sides of the olfactory chamber. The shape of the bony lamella varies in the different groups and seems to be quite constant in members of the same genus. In *Cratogeomys* (pl. 18, fig. 4), *Orthogeomys* (fig. 60), and *Geomys* proper (pl. 18, fig. 1), it is somewhat like a half crescent, with the base above, and the apex pointing to the end of the presphenoid, the anterior border being convex downward. In *Platygeomys* it is similar, except that the upper part is strongly rounded anteriorly, the upper edge being shorter than that part of the lamella immediately below it (pl. 18, fig. 5). In *Heterogeomys* it is relatively small and strongly convex anteriorly (pl. 18, fig. 3). In *Zygogeomys* it is nearly rectangular and the front edge is nearly straight (pl. 18, fig. 2). In *Pappageomys* (fig. 57) it is higher than long, and its inferior border dips down between the wings of the vomer—a unique condition.

(3) The *os planum* is a thin sheet of bone which lines the posterior part of the olfactory chamber (fig. 10, *op*). It supports the endoturbinals and binds them together (as may be seen by consulting fig. 10 and

pl. 19, figs. 3, 4, and 5 of *Geomys bursarius*, *Heterogeomys*, and *Zygogeomys*). Inferiorly it articulates with the vertical lamella of the maxillary which lines the nasal passage, and with the anterior ends of the ascending wings of the palatines. Near its lower border (just below the fourth turbinal), it gives off a lateral shelf, which is firmly ankylosed to the outer side of the posterior third of vomer. In *Cratogeomys* its antero-inferior border is cut off close to the turbinal folds, giving the latter a

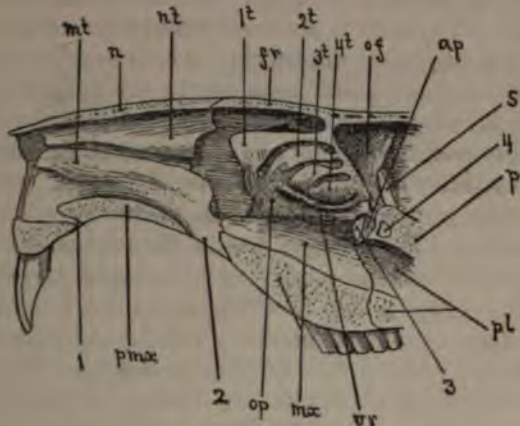


FIG 10.—Longitudal vertical median section of front part of skull of *Geomys bursarius*. Mesethmoid and vomer removed to show turbinated bones.

1 Anterior palatine foramen.
2 Incisive foramen.
3 Vacuity in front of presphenoid (present in *Geomys bursarius* and *tuza* only. It is partly overlapped posteriorly by the ascending wing of the vertical plate of the palatine, *ap.*).
4 Presphenoid fenestrum. Present in all species.
5 Upper part of sphenoidal fissure.
1*t* First or superior endoturbinal.
2*t* Second endoturbinal.
3*t* Third endoturbinal.
4*t* Fourth endoturbinal.
ap Ascending wing of vertical plate of palatine.
fr Frontal.
mt Maxillo-turbinal.
mx Maxilla (the upper pointer rests on the maxillary surface of the narial passage, the lower on the sawed body of the bone).
n Nasal.
nt Naso-turbinal.
op Os planum.
pl Palatine (the upper pointer rests on the palatine face of the narial passage, the lower on the sawed horizontal body of the bone).
pmx Premaxilla.
ps Presphenoid.
vr Vomerine ridge of os planum (unites with the lateral wing of the vomer).

particularly neat and finished appearance (pl. 19, fig. 6). In *Geomys bursarius*, on the other hand, it falls directly downward from the first turbinal, projecting as a thin sheet considerably in front of the others (fig. 10 and pl. 19, fig. 3).

(4) The *ectoturbinals* * arise from the upper and outer corners of the cribriform plate and occupy a small chamber at the maxillary root of the zygoma, incased chiefly by the frontal and maxillary bones. When the lachrymal is removed, they may be seen from the orbital side.

(5) The *endoturbinals* * arise from the outer sides of the anterior face of the cribriform plate (on the inner side of the ectoturbinals) and project into the nasal chamber (fig. 10). They are four in number throughout the family. Their outer sides are continuous with and form a part of the *os planum*. The first or uppermost is always the largest, longest, and most broadly expanded anteriorly. The others decrease in length from above downward, and are broadest in the middle or posteriorly. The fourth or lowermost is broader and shorter than the two middle ones. The first or uppermost is the only one that need be considered from the standpoint of variation of form in the several groups. Its front border usually slopes strongly backward (from above downward), as in *Platygeomys*, *Cratogeomys*, and *Zygogeomys;* but in *Heterogeomys* it is straight or slightly emarginate, vertical, and very broad, and carries with it the second fold (see pl. 19, fig. 5). In *Platygeomys* it is long and relatively slender, and its apex projects anteriorly behind the posterior border of the nasoturbinal (pl. 19, fig. 7). In *Zygogeomys* also it is pointed and projects far forward (pl. 19, fig. 4). In *Geomys bursarius* it is rather bluntly rounded (fig. 10, and pl. 19, fig. 3).

The *vomer* is a long and narrow plate of bone, cleft above and bifurcate posteriorly, which forms the lower part of the longitudinal vertical septum between the lateral chambers of the nasal cavity (fig. 7, *v*). It consists of a median plate and two wings. The median plate is embraced inferiorly between the wings of the vomerine sheath (which rises from the floor of the premaxilla and extreme anterior part of the maxilla). Superiorly it is split lengthwise from above, forming the two wings, between which the mesethmoid cartilage is received. These wings are narrowed posteriorly and reach the front end of the presphenoid, which they clasp laterally, but they do not appear on the inferior surface of the presphenoid, as they do in most mammals. Posteriorly the wings of the vomer separate slightly and are not united inferiorly. On the outer side they are inseparably united with the *os planum* just below the fourth endoturbinal, thus continuing anteriorly the roof of the narial passage, which is here sharply separated from the olfactory chamber above. The vomer articulates with the premaxilla, maxilla, ethmoid, presphenoid, and palatines.

The *pterygoids* are more or less quadrangular vertical plates, forming the lateral walls of the posterior nares (figs. 4 and 7, *pt*). Anteriorly they articulate with the vertical plates of the palatines; superiorly they are firmly ankylosed to the basisphenoid, and usually also with the posterior downward extension of the transverse arm of the alisphenoid.

* These terms are adopted from Dr. Harrison Allen's admirable paper on the Ethmoid.—(Bull. Mus. Comp. Zool., Cambridge, X, No. 3, 1882, 136.)

They commonly develop a hamular process (figs. 4 and 7, *h*), which curves upward and reaches or nearly reaches the audital bulla (except in *Heterogeomys*). The inferior surface of the pterygoid is usually flattened, either horizontally or obliquely; it may be of uniform breadth (fig. 11[2]), or much broader anteriorly than posteriorly (figs. 11[3] and 11[4]). It reaches its maximum length and slenderness in *Zygogeomys* (fig. 11[1]); its maximum breadth and shortness in *Macrogeomys* (fig. 11[5]). The two arms may be divergent posteriorly, convergent posteriorly, or parallel.

1 2 3 4 5

FIG. 11.—Principal types of palato-pterygoids.

1. *Zygogeomys trichopus.* 2. *Geomys lutescens.* 3. *Geomys bursarius.* 4. *Heterogeomys hispidus.* 5. *Macrogeomys heterodus.*

In the share they take in the formation of the palato-pterygoid plates on the roof of the mouth, and the manner of articulation with the palatine bones, the pterygoids present five types, as follows:

(1) They completely surround the postpalatal notch like a horseshoe, meeting or so nearly meeting anteriorly that at most a narrow spicule of the palatine reaches the notch in the median line. This type occurs in the genus *Zygogeomys* only (fig. 11[1]).

(2) They form the whole or practically the whole of the sides of the postpalatal notch, but are separated anteriorly by the full breadth of the notch itself. This is the commonest type and prevails in the genera *Geomys* and *Cratogeomys* (fig. 11[2]).

(3) They are lingulate in shape and do not reach the base of the postpalatal notch, the palatine bones extending out a considerable distance to meet them. This is the ordinary condition in *Geomys bursarius* (fig. 11[3]).

(4) They are very much reduced, forming only the terminal part of the palato-pterygoid plates, the palatine part of which is greatly elongated. This condition obtains in *Heterogeomys* (fig. 11[4]).

(5) They are short, broad, and abruptly upturned, capping the ends of the very broad palatines. This type is restricted to *Macrogeomys* (fig. 11[5]).

The *palatine* bones contribute an insignificant part to the external surface of the skull (fig. 12, *pl*), but internally their connections are extensive and important (fig. 7, *pl*, and fig. 10, *pl* and *ap*). They early unite (probably before birth) in the median line, forming a single bone, which may be described as consisting of a body, two vertical plates, and two lateral wings or external ptergoid plates. The *body* or horizontal part enters the roof of the mouth posteriorly, forming a wedge between the hinder part of the maxillaries, and never reaching further forward than the middle molars (fig 12, *pl*). This part is cut away posteriorly, so that its inferior surface is on two planes. Anteriorly it is continuous with the plane of the bony palate; posteriorly with the pterygoids. The break in the palatines between these two planes occurs suddenly between the posterior molars, forming a step or pit on each side between the last molar and a median azygos projection of the palate, which connects the two more gradually. Posteriorly the palatals may terminate opposite the anterior end of the postpalatal notch (as usual in *Cratogeomys*), or they may extend out a short distance beyond the apex of the notch (as in *Geomys* proper), or they may push back still farther, forming more than half of the side walls of the notch (as in *Heterogeomys*), or they may fail to reach the notch at all, the pterygoids coming forward to the median line (as in *Zygogeomys*). [See fig. 11 *supra*.]

The *vertical plates* are thin lamellæ, which reach upward on each side from the body of the bone to the presphenoid, surrounding the middle section of the narial passage between the maxilla and pterygoid (fig. 7, *pl*). Their upper borders reach the basisphenoid anteriorly and are in contact with the presphenoid for its entire length; anteriorly they clasp the sides of the presphenoid and articulate with the ethmoid and frontal—the descending processes of the latter overlapping their anterior prolongations. The front border of the vertical plate of the palatine, on the side of the narial passage, articulates with the corresponding part of the maxilla; the hinder border with the pterygoid. In *Geomys bursarius* the vertical plate rises anteriorly in an *ascending wing* which hugs the prespenoid anteriorly and articulates broadly with the orbitosphenoid, frontal, and maxilla (fig. 10, *ap*).

Posteriorly the body of the palatine sends off, on each side, a lateral wing—the *external pterygoid plate*—which pushes its way around behind the maxilla and along the inner side of the descending wing of the alisphenoid as far as the point where the latter is joined by the transverse arm of the same bone (immediately below the alisphenoid canal), and sometimes sends a spicule backward to the audital bulla (fig 12, *epl*). The external pterygoid plate of the palatine thus forms the outer wall of the pterygoid fossa inferiorly. It is completely overlapped externally by the descending wing of the alisphenoid, except along its inferior margin, which projects slightly below the alisphenoid, thus appearing on the outer side of the skull (fig. 4, *epl*).

The palatines articulate with the maxilla, pterygoids, alisphenoids, basisphenoid, presphenoid, frontals, vomer, and ethmoids and sometimes also within the orbitosphenoids and the tympanic bullæ.

The *maxilla* is the largest, and after the ethmoid the most complicated bone of the skull, and comprises, roughly speaking, about one third of the entire cranium (fig. 12, *mx*). It primarily consists of two parts, which are firmly united by ankylosis in very early life (probably before birth), forming a single strong bone for the support of the grinding teeth. It articulates with nearly all the bones of the face and with those of the anterior segment of the brain case, as follows: Anteriorly with the premaxilla, ethmoid and lachrymals; superiorly with the presphenoid and frontal; posteriorly with the palatines and alisphenoid, and externally with the jugals. The maxilla forms nearly the whole of the roof of the mouth, the palatines entering it merely as a wedge from behind. The densest and hardest part of the skull, after the floor of the premaxilla, is the median part of the maxilla between the

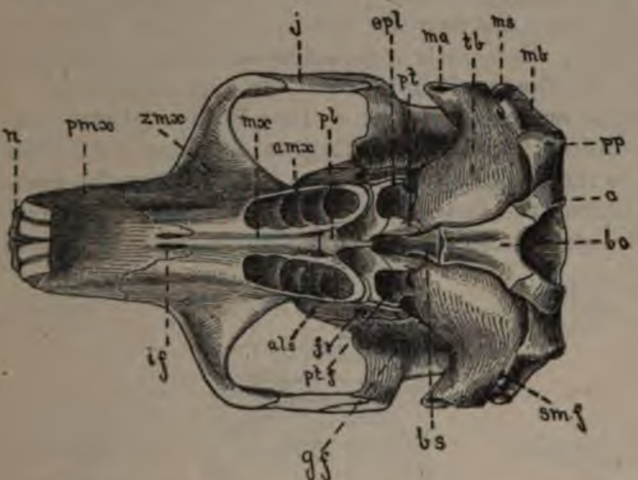


FIG. 12.—Under side of young skull of *Cratogeomys merriami*. (Specimen from Amecameca, Valley of Mexico.)

als Alisphenoid.
amx Alveolar border of maxilla.
bo Basioccipital.
bs Basisphenoid.
c Condyle of exoccipital.
epl External pterygoid plate of palatine.
fr Foramen rotundum.
gf Glenoid fossa.
if Incisive foramen.
Jugal.
ma External auditory meatus.
mb Mastoid bulla.
ms Mastoid process of squamosal.
mx Maxilla.
n Nasal.
pl Palatine.
pmx Premaxilla.
pp Paroccipital process of exoccipital.
pt Pterygoid.
ptf Pterygoid fossa.
smf Stylo-mastoid foramen.
tb Tympanic or audital bulla.
zmx Zygomatic process of maxilla.

molariform teeth. The infraorbital canal is deeply imbedded in the maxilla and is very long, reaching back from near the premaxillary suture on the side of the muzzle to the bottom of the orbit. In the *Geomyidæ* it never perforates the zygomatic root of the maxilla, but passes deeply behind it.

The maxilla gives off anteriorly a vertical lamella, which rises from the median line of the floor of the nasal chamber and projects forward a short distance into the posterior part of the vomerine sheath of the premaxilla (fig. 13, *ms*). It is split lengthwise to receive the posterior part of the median plate of the vomer, but the resulting wings do not spread apart as in the premaxillary part of the vomerine sheath.

On each side of the nasal passage the body of the maxilla gives off a thin vertical plate or lamella, which may be termed the *internal vertical plate of the maxilla.* It forms a lining for the narial passage and articulates above with the lower edge of the os planum of the endoturbinal. The infraorbital canal passes for nearly its entire length between this thin plate and the main part of the maxilla.

The *premaxilla* is a single bone in the *Geomyidæ* (its two halves uniting before birth, fig. 12, *pmx*). It constitutes the greater part of the rostrum and forms the floor and lateral walls of the anterior half of the nasal chamber. Superiorly it embraces the nasals and articulates with the frontal and the maxillary root of the zygoma; laterally it articulates with the outer side of the maxilla a little anterior to the plane of the infraorbital foramen; inferiorly it articulates with the maxilla posterior to the middle of the rostrum, and reaches far enough backward to inclose the *incisive foramina* (fig. 12, *if*) in all except *Zygogeomys trichopus.* Anteriorly it is perforated on the median line by the

FIG. 13.—Longitudinal vertical section of nasal chamber of *Cratogeomys merriami.* The vomer has been removed to show the vomerine sheath and anterior turbinated bones.

1 Anterior palatine foramen.
2 Incisive foramen.
mt Maxillo-turbinal.
ms Maxillary part of vomerine sheath (which passes anteriorly into the premaxillary part of the sheath).
mx Maxillary.
n Nasal.
nt Naso-turbinal.
pmx Premaxilla.
vs Vomerine sheath of premaxilla.

anterior palatine foramen, which descends from the floor of the nasal chamber to the roof of the mouth, immediately behind the incisors (figs. 7, 10 and 13 [1]). On the inner side it supports the *maxillo-turbinals* and the *vomerine sheath,* which latter structure attains a high development in this group, particularly in *Platygeomys* and *Cratogeomys.*

The *vomerine sheath* (fig. 13, *vs*) is a double lamella rising from the floor of the premaxilla on the median line and projecting into the nasal cavity. It is elongated antero-posteriorly, reaching from the hinder end of the premaxilla forward over half or two-thirds the floor of the bone. Posteriorly it receives the anterior end of the corresponding (but very much smaller and narrower) part of the maxilla; superiorly it receives the median vertical plate of the vomer.

The *maxillo-turbinal*, or *inferior turbinated bone* (figs. 7, 10, and 13, *mt*), is the lower of the two turbinated bones of the anterior half of the nasal cavity (the upper being attached to the nasal). It is nearly horizontal, though usually sloping downward posteriorly, and is attached to the middle part of the inner side of the premaxilla; its free posterior end projects slightly over the front of the maxilla.

The premaxilla articulates with the nasals, frontal, maxilla, vomer, and ethmoid.

The *jugal* completes the zygomatic arch, and is always restricted to the horizontal part, never reaching down posteriorly into the glenoid fossa, and never creeping up anteriorly toward the lachrymal (figs. 9 and 12, *j*). But its variations in size and form are remarkable (fig. 14 and pl. 13). In some species it is very large and broadly expanded anteriorly (fig. 14^{1}); in others it is reduced to an insignificant splint, and the zygomatic arch is complete without it (fig. 14^{6}). It is commonly larger and broader in the male than the female, and sometimes

FIG. 14.—Left zygoma, showing several types of jugal.

1. *Platygeomys tylorhinus.*
2. *Heterogeomys hispidus.*
3. *Macrogeomys heterodus.*
4. *Geomys bursarius.*
5. *Cratogeomys perotensis.*
6. *Zygogeomys trichopus.*

varies greatly in species of the same genus and even in the same section. Thus, in *Platygeomys* it is greatly expanded in *gymnurus* and *tylorhinus*, and is slender throughout in *planiceps*. Similarly, in *Cratogeomys* it is broad anteriorly in *merriami*, *fulvescens*, and *castanops*, while in *perotensis* it is slender and small in every way.

The *lachrymal* is a small L-shaped bone, consisting of a *vertical* scale-like part, which closes the vacuity between the frontal and maxillary root of the zygoma at the inner corner of the orbit; and a thickened *horizontal* part which projects outward from the frontal on the upper surface of the skull and articulates also with the maxillary root of the zygoma. Its distal end is sometimes elongated and slightly recurved, and projects freely over the corner of the orbit. The principal or vertical part of the lachrymal is grooved vertically on its outer side, just anterior to the orbital face, for the lachrymal duct which passes down into the nasal chamber.

The *nasal* bones fill the interspace between the ascending arms of the premaxilla on top of the rostrum, thus completing the roof of the nasal cavity, which they slightly overhang anteriorly (figs. 8 and 9, *n*).

They are commonly ankylosed together in middle life, and not infrequently become ankylosed to the frontals also. Their actual length varies greatly in the different species. They are shortest in *Cratogeomys estor* and longest in *Zygogeomys trichopus* and *Geomys tuza*. They are commonly truncate wedge-shaped; the increase in breadth from behind forward may be gradual or abrupt. In the latter case the expansion is usually near the middle. In the *Geomys tuza* group the shape of the nasals is peculiar. They are very long and are constricted near the middle, giving them an hour-glass shape. In most of the genera (*Geomys*, *Cratogeomys*, *Platygeomys*, *Zygogeomys*) the nasals are nearly flat, though they are always more or less decurved anteriorly and rounded off laterally in front. But in some groups (notably in *Heterogeomys*) they are broadly and highly *arched* anteriorly, giving them an inflated appearance. This elevated part of the nasal supports the naked nasal pad or callosity. Inferiorly the nasals give off a descending lamella, the *nasoturbinal* bone, which is elongated antero-posteriorly and is broadest behind.

The nasals articulate with the premaxilla, frontal, and ethmoid.

The *tympano-periotic capsule* incompletely fills a broad gap in the posterior segment of the skull, between the basioccipital and squamosal (figs. 4, 7, and 9). It is held in place by several bones with which its connection is more or less intimate, but is never ankylosed to any of them except in extreme age, when the mastoid process of the mastoid bulla sometimes unites with the mastoid process of the squamosal. Its principal stays are the exoccipital and the mastoid process of the squamosal, between which the mastoid bulla is firmly grasped posteriorly. In addition to these supports, the inner border of the audital bulla commonly fits into a groove on the outer edge of the basioccipital, and the apex of the bulla rests against the base of the horizontal arm of the alisphenoid near its junction with the basisphenoid. The tympano-periotic mass as a whole thus has four normal attachments, two of which hold it firmly in place, while the others simply steady it in its position. In old age the lower edge of the squamosal sometimes reaches the upper side of the bulla and presses firmly against it.

The *tympano-periotic capsule* consists of three parts, firmly ankylosed together: (1) the *tympanic*, or audital bulla; (2) the *petrous*, or periotic proper; (3) and the *mastoid* bulla. Of these, the mastoid is posterior to the others, both of which are inseparably ankylosed to its anterior face. The tympanic protrudes from the base of the skull, forming the *audital bullæ*. The *petrous* projects into the brain case and contains the organ of hearing. No suture or other line of demarcation indicates the exact place of meeting of the mastoid with either the petrous or tympanic, but anteriorly the line of union between the two latter is always distinct. The three elements may be described as follows:

(1) The *tympanic* or audital bulla is almost wholly inferior, projecting from the under surface of the outer segment of the cranium between the

pital and squamosal (figs. 4 and 12, *tb*). Anteriorly it is bounded *foramen lacerum medium basis cranii*, in front of which is the rse bar of the alisphenoid. Superiorly it is separated from the sal by a long, irregular vacuity reaching upward and backward e foramen lacerum medium to the tube of the external meatus, tter articulates with the squamosal. Posteriorly it abuts against toid process of the squamosal above, and the exoccipital below, ontinuous with the mastoid bulla. Externally it sends off at igles a long tube which partly fills the postglenoid notch and ist behind the posterior angle of the zygoma (fig. 12, *ma*). This xternal auditory meatus (fig. 4[5]). The tube of the meatus orward and somewhat upward as well as outward, and forms terior boundary of the glenoid fossa, against which the condyle w strikes during the to and fro movement of mastication. The g upper part of the outer side of the bulla forms the inner side lenoid fossa. It is thus apparent that this fossa, while mainly quamosal, is completed posteriorly by the tympanic bulla. The de of the bulla fits into a longitudinal groove on the outer edge ody of the basioccipital, and the extreme anterior end just above ance of the Eustachian canal rests against the horizontal arm lisphenoid, which sometimes, as in *Cratogeomys*, sends back a ngue of bone to cover its apex. The canal for the internal artery is absent. On the inferior surface, between the mastoid panic bullæ, is a small opening, the *stylomastoid foramen* (fig. . The tympanic bulla arches over and protects the tympanum openings leading into the internal ear.

he *petrous*, or periotic proper, in which is lodged the organ of , is not visible from the outer side of the skull, but is conspicu- he inner side (figs. 7 and 9, *pet*), where it is saddled upon the ic capsule, which it does not completely cover, a considerable the bulla protruding anteriorly (figs. 7 and 9, *tb*). The line of tion between the two is always evident. The anterior border petrous begins near the middle of the inferior margin of the rface of the bulla and curves upward and forward to the front he ridge that separates the inner from the superior surface of e. On the outer side of this ridge it turns back, forming a deep t angle, at the apex of which is a small foramen. The petrous only described as a very hard bone. It is not so in the *Geomyidæ*, ft and spongy, being made up of cancellous tissue like the rest ympano periotic capsule. It contains the cochlea (coiled in a cone of 4½ turns), the semicircular canals, and the three small f the internal ear—the *malleus*, *incus*, and *stapes*. The petrous described as presenting two surfaces, a *superior* and an *inner*. *erior* surface is narrow, slopes downward from behind forward, cooped out lengthwise. It is more or less completely separated e inner surface by a ridge, which in some forms is sharply

fossa (fig. 7[1] and fig. 9, *ff*). The *floccular fossa* varies in size an[d]
in the several genera. Its position is always above and poster[ior]
the internal meatus, from which it is separated by an elevation
sometimes amounts to a strongly developed ridge (see pls. 17 a[nd]
The ridge is marked in *Cratogeomys*, but not in *Platygeomys*, *Het*[...]
mys, or *Geomys* proper. In *Zygogeomys* it is not only present[,]
supplementary ridge bounds the floccular fossa posteriorly, [...]
another depression behind it, so that the bone presents the appe[arance]
of having two floccular fossæ (pl. 17, fig. 2, and pl. 18, fig. 2).

(3) The *mastoid bulla* forms the hindermost part of the au[ditory]
apparatus (fig. 4, *mb*). It appears on the outer side of the occipita[l]
as a more or less rounded subtriangular mass, convex posteriorl[y]
the base toward the median line and the blunt apex (*mastoid*
proper, fig. 4, *m*) directed outward. It is grasped and held in p[lace]
the paroccipital process of the exoccipital below (figs. 4 and 12, *p*[...]
the long mastoid process of the squamosal above (fig. 4, *ms*). T[he]
mer fits into a notch on the under side between the mastoid and [...]
bullæ. The latter reaches far outward and curves down upon th[e]
of the mastoid process, which it overreaches enough to effectually
the action of the exoccipital. The mastoid bulla, viewed from b[...]
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geomys and *Geomys* (particularly in the *tuza* series). It is s[...]
triangular in *Macrogeomys dolichocephalus;* triangular with [...]
stricted and elongated neck in *M. heterodus*, and much pr[...]
laterally with the inferior border concave in *Platygeomys*. Int[...]

ngly and rather shortly curved upward longitudinally, and is ader behind than in front; it also curves outward. There is no aration into horizontal and ascending rami, although when viewed n the inner side the condylar and coronoid part might be regarded as ning an ascending ramus. The outer side gives off posteriorly, at ht angles to its axis, a strongly defined *angular process* which is ays important and in some forms, particularly in *Platygeomys*, attains rmous proportions (pl. 10, fig. 8). Between the angular process and ndyle is a subglobular prominence which covers the root of the long isor. The coronoid process is broad at the base anteroposteriorly; apex is hamular and rises above the plane of the condyle. In some ms (notably in *Platygeomys*) a strong shelf-like ridge runs from the terior base of the coronoid to the angular process. The *masseteric* sa is always well defined and reaches anteriorly to the plane of the nt of the premolar. On the outer side of the last two molars is a ge and deep pit for the insertion of the principal part of the temporal scle (pls. 1–7). The dental foramen enters the ramus just behind s pit and just below the condylar process. Behind the symphysis, eriorly, is a flange-like prominence for the insertion of the digastric scle. The principal differences in the form of the mandible as a ole result from the amount of spreading posteriorly and the degree development of the angular processes. The various types, as seen m below, are shown on Pl. 10. In some cases the base of the angular ocess is notched anteriorly, as in *Geomys mobilensis* (pl. 10, fig. 2.)

3. CHANGES WITH AGE.

Throughout the *Geomyidæ*, except in *Pappogeomys*, and some species *Thomomys*, the form of the cranium as a whole, and the pattern of e sutures on the upper surface change greatly with age. The change rks the transition from immaturity to maturity—from the generalized pe that stands for the group to the specialized type that bears the press of the species. When the skull of a species fails to show rked differences with age, that species may be set down as a gener- zed type—one that is probably but little removed from the ancestral e. For this reason *Pappogeomys bulleri* is looked upon as very near e trunk line of the group.

The principal changes in the form of the skull as a whole resulting m age are: The broadening out of the zygomatic arches, elongation the rostrum, expansion of the squamosal, and development of the sts and ridges that come with maturity. The anterior or maxillary t of the zygoma at first slopes strongly backward in all species, and arches themselves are narrower anteriorly than posteriorly (as is rule in adults of *Thomomys*). With advancing age they spread apart teriorly until in most species they are much broader anteriorly than teriorly. At the same time the maxillary root stands out more and re squarely until it sometimes forms almost a right angle to the axis marked; in others is inconspicuous. This ridge presents various degrees of development in the different groups. It is rounded off in *Platygeomys*, but is elevated into a distinct crest in *Cratogeomys*, *Zygogeomys*, *Heterogeomys*, and *Geomys* proper (pls. 17 and 18). It usually reaches upward and backward to the upper part of the audital mass, but in *Heterogeomys* it fails posteriorly, but forms a sharply elevated ridge from the plane of the flocculus downward (pl. 18, fig. 3). The *inner face* of the *petrous* is always perforated by the *internal auditory meatus* (fig. 7[3] and fig. 9, *ma*), above which is a depression called the *floccular fossa* (fig. 7[4] and fig. 9, *ff*). The *floccular fossa* varies in size and form in the several genera. Its position is always above and posterior to the internal meatus, from which it is separated by an elevation which sometimes amounts to a strongly developed ridge (see pls. 17 and 18). The ridge is marked in *Cratogeomys*, but not in *Platygeomys*, *Heterogeomys*, or *Geomys* proper. In *Zygogeomys* it is not only present, but a supplementary ridge bounds the floccular fossa posteriorly, leaving another depression behind it, so that the bone presents the appearance of having two floccular fossæ (pl. 17, fig. 2, and pl. 18, fig. 2).

(3) The *mastoid bulla* forms the hindermost part of the auditory apparatus (fig. 4, *mb*). It appears on the outer side of the occipital plane as a more or less rounded subtriangular mass, convex posteriorly, with the base toward the median line and the blunt apex (*mastoid process* proper, fig. 4, *m*) directed outward. It is grasped and held in place by the paroccipital process of the exoccipital below (figs. 4 and 12, *pp*), and the long mastoid process of the squamosal above (fig. 4, *ms*). The former fits into a notch on the under side between the mastoid and audital bullæ. The latter reaches far outward and curves down upon the head of the mastoid process, which it overreaches enough to effectually oppose the action of the exoccipital. The mastoid bulla, viewed from behind, differs considerably in form in the several genera, and presents specific differences also (pl. 15, figs. 3–7). It is short and rounded in *Zygogeomys* and *Geomys* (particularly in the *tuza* series). It is strongly triangular in *Macrogeomys dolichocephalus;* triangular with a constricted and elongated neck in *M. heterodus*, and much produced laterally with the inferior border concave in *Platygeomys*. Internally the mastoid bulla is made up of fine cancellous tissue.

The *mandible* is usually a large and heavy bone, strongly marked by processes and ridges for the attachment of the powerful muscles that move it. To be understood, it should be studied as a part of the cutting and slicing machine, for it consists, on each side, of a curved beam or plate built expressly to carry the ponderous chisel-edged incisors and the series of parallel cutting blades of the lower molariform teeth. The two halves are joined together by an elongated symphysis which admits of a certain amount of movement, and the adjustment is aided by a transverse muscle which helps bind the jaws together above the posterior half of the symphysis. Each half of the mandible is ongly and rather shortly curved upward longitudinally, and is oader behind than in front; it also curves outward. There is no paration into horizontal and ascending rami, although when viewed m the inner side the condylar and coronoid part might be regarded as ming an ascending ramus. The outer side gives off posteriorly, at ht angles to its axis, a strongly defined *angular process* which is ways important and in some forms, particularly in *Platygeomys*, attains ormous proportions (pl. 10, fig. 8). Between the angular process and ndyle is a subglobular prominence which covers the root of the long cisor. The coronoid process is broad at the base anteroposteriorly; apex is hamular and rises above the plane of the condyle. In some rms (notably in *Platygeomys*) a strong shelf-like ridge runs from the terior base of the coronoid to the angular process. The *masseteric ssa* is always well defined and reaches anteriorly to the plane of the ont of the premolar. On the outer side of the last two molars is a rge and deep pit for the insertion of the principal part of the temporal uscle (pls. 1–7). The dental foramen enters the ramus just behind is pit and just below the condylar process. Behind the symphysis, feriorly, is a flange-like prominence for the insertion of the digastric uscle. The principal differences in the form of the mandible as a hole result from the amount of spreading posteriorly and the degree development of the angular processes. The various types, as seen om below, are shown on Pl. 10. In some cases the base of the angular ocess is notched anteriorly, as in *Geomys mobilensis* (pl. 10, fig. 2.)

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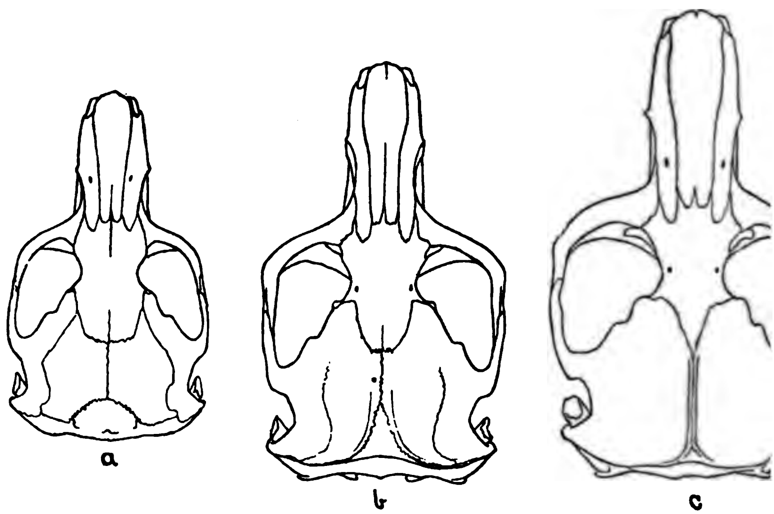

FIG. 15.—*Zygogeomys trichopus*, showing changes with age. *a*, Young; *b*, young adult; *c*, [...]

forms an important part of the roof of the brain case, as seen from [...] (figs. 8, 15*a*, and 16*b*). In old skulls it is reduced posteriorly, in [...] species, to a small wedge between the greatly expanded anterior ex[...] ities of the parietals and squamosals (see pl. 1; pl. 15, fig. 2; an[...] fig. 15, *c*, for adults of same species figured in figs. 8, 15, *a* and 16 [...]

The changes in the suture pattern result mainly from the grow[...] the parietals both anteriorly and posteriorly, with consequent sh[...] age of the interparietal, and the progressive development of the [...] mosal. The decrease in the size of the interparietal corresponds [...] the movement of the temporal impressions, which approximate [...] age, and in many species finally meet in a sagittal crest. The pa[...] not only tend to cover the interparietal by meeting posteriorly [...] it, but anteriorly they overlap the sides of the frontal, altering its [...] entirely. The progressive development of the squamosals in species, as elsewhere shown, is even more remarkable than that of the parietals.

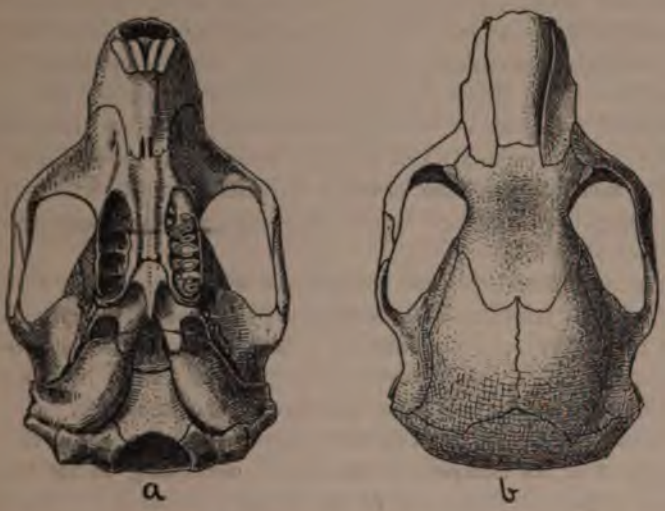

FIG. 18.—Skull of very young *Heterogeomys torridus* from Motzorongo, Mexico (No. 63643). *a*, lower surface; *b*, upper surface. For key to bones see figs. 8 and 12.

4. COÖSSIFICATION OF THE PAIRED BONES.

Nearly all the paired bones that meet in the median line become firmly ankylosed together before birth or in very early life. Those that are thus coossified are the premaxillaries, maxillaries, palatines, parietals, frontals, and frequently the nasals also. Of these, all except the parietals and nasals are ankylosed before birth (see figs. 8 and 16).

The single bones forming the basicranial axis are early ankylosed with the adjoining paired bones of the same segments. Thus the presphenoid is inseparably united with the orbitosphenoids; the basisphenoid with the alisphenoids and pterygoids; the basioccipital with the exoccipitals. The union of the lateral with the median elements of the sphenoidal segments occurs before birth; that of the occipital segment later. The exoccipitals are always distinct in early life (figs. 12 and 16), but soon become ankylosed with the basioccipital below and the supraoccipital above. The latter, except in a few species, is inseparable from the interparietal. The parietals in adult life are commonly ankylosed with the squamosals.

5. CRANIAL VARIATIONS—DEPARTURES FROM THE TRUNK LINE.

In external appearance the members of the family *Geomyidæ* are very much alike, but in cranial characters they present several marked generic types. The skulls of these types differ in size, massiveness, and degree of development of the crests, ridges, and processes from the small, thin, and smoothly rounded skulls of *Geomys texensis* and *bulleri* to the huge angular craniums of *Platygeomys gymnurus* and *Cratogeomys merriami;* and the large, massive skulls differ in the breadth of the cranium and lateral production of the angle of the mandible from the extraordinarily broad and flat *Platygeomys gymnurus* to the long and narrow *Orthogeomys scalops* and *Macrogeomys dolichocephalus*. The skulls differ further—and this is much more important—in the relative development and relations of certain bones which here assume proportions and conditions previously unknown. Most if not all of these remarkable extremes of form are clearly secondary modifications resulting from the highly specialized types of dental armature possessed by the animals, as shown later.

The parts of the skull that exhibit the widest variation and play the most important part in giving to each type its peculiar impress or physiognomy are the *zygomatic arches*, the *roof of the brain case*, and the *occiput*. The individual bones that present the greatest range in size and form are the *frontal*, *squamosal*, *jugal*, *pterygoid*, and *mandible*.

The *zygomatic arch* varies exceedingly in size, form, and the relative development of its component elements, according to its importance as a support for the jugal part of the masseter muscle. It may be small and slender, with the horizontal part reduced to a mere rod, as in *Pappogeomys bulleri* (pl. 13, fig. 15) and *Orthogeomys latifrons* (pl. 13, fig. 16), or it may be large and massive, with the angle and horizontal arm broadly expanded, as in *Platygeomys* (pl. 13, figs. 1 and 2), *Cratogeomys* (pl. 13, fig. 4), and *Heterogeomys* (pl. 13, fig. 20). The area for the attachment of the jugal part of the masseter muscle may be small and posterior (fig. 49, *jo*), or large and extending the full length of the outer side of the zygoma (fig. 50, *jo*). The arches may be small and narrow with their outer sides nearly parallel, as in *Macrogeomys dolichocephalus* (pl. 5) and *Orthogeomys scalops* (pl. 19, fig. 1), or they may be massive, widely spreading, and broadly divergent anteriorly, as in *Platygeomys* (pl. 3) and *Cratogeomys* (pl. 2). The ratio of their breadth to the basal length of the skull varies from 54 percent in *Macrogeomys dolichocephalus* to upward of 88 percent in *Platygeomys tylorhinus*, a difference of 34 percent. They may be slightly or strongly decurved; the horizontal part may be lowest anteriorly as in *Platygeomys gymnurus* (pl. 13, fig. 2), or highest anteriorly, as in *Macrogeomys dolichocephalus* (pl. 13, fig. 19), and the angle may be small (pl. 13, figs. 15, 16, and 24) or broadly expanded (pl. 13, figs. 1, 2, 4, 17, and 18). The expansion, which normally covers the antero-external angle, as in *Platygeomys*, *Cratogeomys*, and *Heterogeomys* (pl. 13, figs. 1, 2, 4, etc.) may be drawn backward so as to occupy the middle part of the horizontal arm, as in *Macrogeomys costaricensis* and *dolichocephalus* (pl. 13, figs. 19 and 23). In the latter the zygomatic arch presents a peculiarity not observed in any other member of the group. It is narrow, broadly rounded antero-externally, without the expansion of the angle common to *Cratogeomys*, *Platygeomys*, and *Heterogeomys*, but with a moderate expansion near the middle of the horizontal arm. This expansion is wholly on the upper or orbital side, and is restricted to the maxillary part of the arch, which here reaches much farther back than usual. On comparing the arch carefully with that of *Macrogeomys heterodus* a curious explanation is suggested, namely, that in the extreme elongation of the skull of *M. dolichocephalus* the anterior root of the zygoma has been moved forward (the posterior root being fixed), increasing the length of the maxillary arm, decreasing the breadth of the arch, obliterating the antero-external angle, elongating the laminar expansion on the orbital side, and carrying its highest point backward to or behind the middle of the orbito-temporal fossa (pl. 13, fig. 19, and text fig. 49). At the same time the upper anterior angle of the jugal has been rounded off, and the maxillary and squamosal arms of the zygoma have nearly clasped hands above it. Furthermore, the zygomatic arch as a whole has been lifted up by the main body of the masseter muscle and as a consequence the anterior end has been raised higher than the posterior (fig. 49, which should be contrasted with the corresponding view of *Platygeomys gymnurus*, in which the front of the arch is drawn down, fig. 50).

The form of the *occiput* as a whole varies considerably in the several groups. In the less specialized forms, such as *Geomys texensis*, *arenarius*, and *breviceps*, and *Pappogeomys bulleri* (pl. 15, fig. 5), it is rounded and bulges posteriorly to such a degree that the lambdoid suture is left a considerable distance in front of it. In *Zygogeomys*, *Cratogeomys*, and *Geomys bursarius* and *lutescens*, the occiput is squarely truncated. In *Heterogeomys* (pl. 15, fig. 4), *Macrogeomys* (pl. 15, fig. 3), and *Orthogeomys* it is rather high and slopes strongly forward; and in *Heterogeomys* it is particularly high above the mastoid bullæ. In *Platygeomys* it is depressed and elongated transversely and presents a unique appearance, the broad flange-like paroccipital processes curving strongly backward, defining laterally a deep basin-shaped cavity which is completed above by the overhanging lambdoid crest (pl. 15, fig. 7).

The form of the *frontal* as seen from above varies greatly in the different groups. In *Geomys*, *Cratogeomys*, *Platygeomys*, and *Zygogeomys* it is narrow and is strongly biconcave between the orbits, with the orbital margins more or less thickened and raised, leaving a longitudinal depression or groove between them (fig. 17^1). In *Heterogeomys* it is broad, flat on top, moderately biconcave between the orbits, and shield-shaped posteriorly, owing to the elevated temporal ridges; but the orbital margins are not rounded, thickened, or raised (fig. 17^2). In *Macrogeomys* it is moderately broad and deeply constricted between the orbits posteriorly. Immediately behind the constriction it expands abruptly at right angles to its axis, forming well-marked postorbital processes which are capped by the apex of the alisphenoid and partly overlapped posteriorly by the squamosal (fig. 17^3). In *Orthogeomys* it is remarkably broad throughout and is not constricted between the orbits (fig. 17^4), though the peculiar inflations at the anterior corners of the orbits in *O. grandis* produce the appearance of a constriction behind them.

The *jugal* varies in size and shape from the large and greatly expanded plate that forms the major part of the outer side of the zygomatic arch in *Platygeomys tylorhinus* (pl. 13, fig. 1), to the rudimentary splint or scale that adheres to the inferior side of the zygoma in *Zygogeomys trichopus*, the arch being complete above without it (pl. 13, fig. 24).

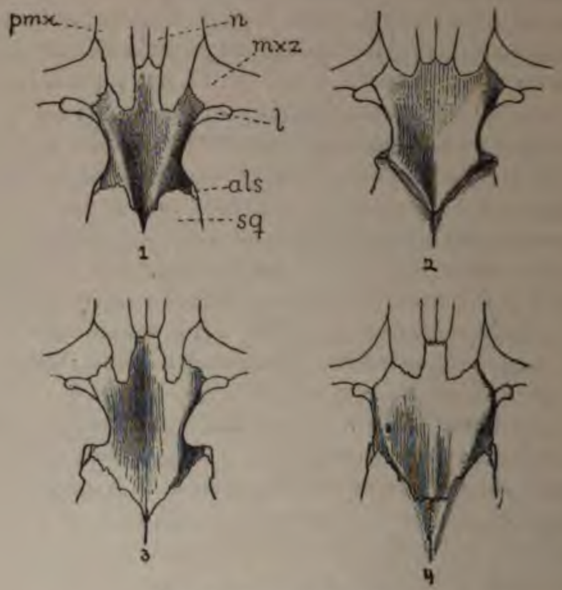

FIG. 17.—Types of frontal.

1. *Cratogeomys merriami.*
2. *Heterogeomys torridus.*
3. *Macrogeomys heterodus.*
4. *Orthogeomys scalops.*

als, apex of alisphenoid; *l*, lachrymal; *mxz*, maxillary root of zygoma; *n*, nasal; *pmx*, ascending or nasal branch of premaxilla; *sq*, squamosal.

The variation in the *squamosal* is hardly less extreme. Throughout the genus, except in the most generalized forms, this bone exhibits a singular tendency toward expansion. In *Geomys* proper the tendency is restricted to a slight overlapping of the postero-lateral moiety of the frontal and lower edge of the parietals. But in the genus *Cratogeomys* its ambition in this direction is not satisfied until the whole of the posterior half of the cranium is covered. In *Cratogeomys merriami* as the animal grows old the upper edges of the squamosals gradually creep up over the parietals until the latter are completely arched over and concealed, the squamosals actually meeting above them along the median line. In doing this the squamosals cover the posterior part of the frontal as well as the whole of the parietals and most of the interparietal, and curve up posteriorly to take part in the formation of the lambdoid crest for its entire length, thus roofing the brain with two distinct layers of bone, the upper of which on each side, consisting of a single bone, overlaps in whole or in part five bones of the lower layer (frontal, parietal, interparietal, supraoccipital, and alisphenoid). The object of this unique arrangement is not only to furnish a brace to the zygoma, to which the powerful masseter muscles are in large part attached, but also to strengthen the vault of the cranium where the huge temporal muscles take origin. The various steps in the development of this extraordinary condition can be distinctly traced in the series of skulls of different ages of *Cratogeomys merriami* collected by Mr. Nelson in the Valley of Mexico. In *Platygeomys* another condition prevails, the squamosal expansion being chiefly *away* from the median line. On the inner side it overlaps the lower part of the parietals as usual; it then extends outward in a broad shelf, carrying the squamosal root of the zygoma far beyond its normal position, and spreading outward and backward so as to completely roof over the postglenoid space, behind which it pushes still further outward and overreaches the extreme end of the transversely elongated mastoid. In *Platygeomys gymnurus*, *tylorhinus*, and *planiceps* the lateral expansion is so excessive that the breadth of the cranium across the squamosals posteriorly is actually greater than the breadth across the widely spreading zygomatic arches (pl. 3).

The *pterygoids* vary surprisingly in size, form, and the extent to which the inferior surface enters into the lateral walls of the postpalatal notch, as already shown (pp. 52–53, and fig. 11). In *Zygogeomys* they are long and slender and encircle the notch like a horseshoe, meeting or nearly meeting in the median line behind the palate (pl. 14, fig. 1). In most species of *Geomys*, *Cratogeomys*, *Pappogeomys*, and *Orthogeomys* they are more or less parallel plates forming the greater part of the walls of the notch but not approximating anteriorly (pl. 14, figs. 7, 11, 13, 15). In *Geomys bursarius* they are more posterior, and taper to nearly a point behind, being lingulate in shape (pl. 14, fig. 2). In *Macrogeomys* they are short and broad and bend abruptly upward, capping the ends of the short and broad palatines (pl. 14, fig. 3). In *Heterogeomys* they are small, and simply form the narrow ends of the elongated posterior arms of the palatines (pl. 14, fig. 12).

The *mandible* is relatively small and light in *Geomys*. It is large and massive in *Cratogeomys*, *Platygeomys*, and the remaining groups. It is long and narrow, with short truncate angular processes, in *Macrogeomys dolichocephalus* (pl. 10, fig. 7). It is broadly spreading, with greatly elongated angular processes, in *Platygeomys gymnurus* (pl. 10, fig. 8).

The degree of development of the angular processes is correlated with definite types of molariform teeth, and affords a key to the dominant movement of the jaw in mastication, the so-called 'grinding movement' being very different in the species with and those without the greatly elongated processes. Where these processes reach their highest development, as in *Platygeomys gymnurus* (pl. 3 and pl. 12, fig. 8, and text figs. 53 and 54) the posterior part of the masseter muscle, arising from the jugal and squamosal arm of the zygoma, is correspondingly large and effective; and since the direction of its fibers is nearly transverse to the axis of the skull, it is evident that the resulting movement of the jaw must be largely lateral. If the two parts of the masseter contract simultaneously, the resulting motion of the jaw would be oblique; if they contract independently, a to-and-fro movement would alternate with a sidewise movement.

In the species in which the lateral production of the angle of the jaw is reduced to a minimum, as in *Macrogeomys dolichocephalus* (pl. 5 and pl. 12, fig. 7; and text figs. 51 and 52) the posterior part of the masseter must be relatively unimportant, and the principal movement must be to and fro. That this is really the case is shown by the greatly restricted area of attachment for the jugal end of this part of the muscle (fig. 49 *jo*), and also by the character of the teeth. As would be expected, the crowns of the molars are broader antero-posteriorly than in the *gymnurus* group, and the tooth row on each side is bowed downward—the crowns of the upper series as a whole being convex, the lower concave, antero-posteriorly (fig. 46). Moreover, the obliquity of the plane of contact of the upper and lower series is less in *dolichocephalus* than in *gymnurus* (see figs. 52 and 54, *f*).*

* The types of molariform teeth coordinated with the two principal types of jaw movement, and hence secondarily with the development of the angular process, are discussed at greater length under the head '*Mechanism and Dynamics of the cutting machine*' (pp. 93–97).

CHAPTER III.

THE DENTAL ARMATURE.

THE TEETH.

The dental formula of the *Geomyidæ* is the same throughout the family, as follows: $i\,\frac{1}{1}$, $c\,\frac{0}{0}$, $pm\,\frac{1}{1}$, $m\,\frac{3}{3} \times 2 = 20$

All of the teeth of the Pocket Gophers are simple rootless* tubular prisms, closed at the top and open at the base. In life the lower part is filled with a soft, pulp-like substance, supplied with blood vessels which replenish the tooth from below, enabling it to grow as long as the animal lives. The hardening of the pulp within the tooth forms

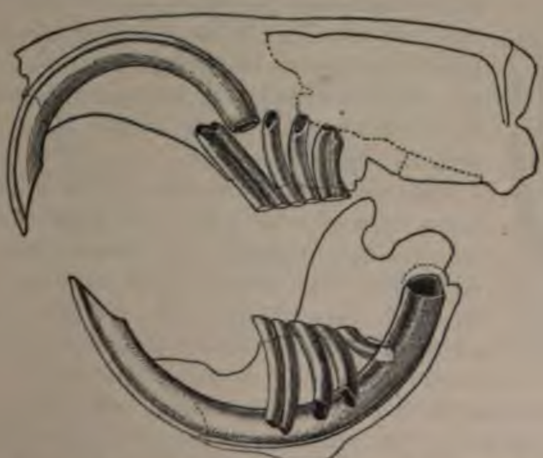

FIG. 18.—Outline of skull of *Platygeomys gymnurus*, showing teeth in situ.

the dentine and osteodentine; the enamel and cement are deposited on the outside. In the adult† the crowns of the teeth are never complicated by infoldings of the enamel; the enamel never envelops the prism continuously and never dips into the interior, but is always attached to the outside in the form of vertical bands or plates like the staves on

*Although the teeth have no true roots, it is convenient to speak of the basal or growing end as the root. The term is used in this sense in the present paper.

†The enamel caps of the young teeth, and changes in the enamel pattern due to immaturity, are fully described under a separate heading (pp. 83–86).

a barrel (pl. 16, fig. 12). The number of enamel plates on each tooth varies from one to four. When the tooth is looked at from the side, the alternating bands of enamel and cement are found to extend vertically from base to crown; and since the tooth is constantly worn down from above and as constantly replenished by growth from below, its original form is preserved and no sensible change in the enamel pattern takes place.

THE INCISORS.

The incisors are long and heavy, with trenchant, chisel-like edges (figs. 18 and 19). Their massiveness varies greatly in the different genera. The upper incisor is shortly curved in a single plane, forming a little more than a complete semicircle, and its root rests either in the upper part of the interspace between the divaricating roots of the premolar and first molar, as in *Platygeomys* (fig. 18), or directly above the root of the first molar, as in some of the other genera. The lower incisor is much longer, less shortly curved, and does not form a complete semicircle. It passes backward beneath and on the inner side of the molars, its own root rotating outward in a partial spiral like the beginning of the twist in a ram's horn, and terminates in a thin capsule of bone on the outer side of the condylar process. The lower incisor is thus considerably longer than the greatest length of the jaw, from which it projects at both ends.

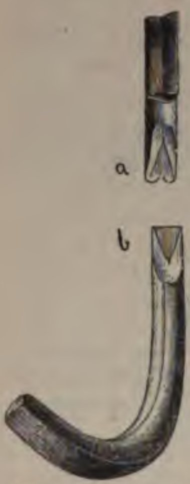

FIG. 19.—Incisors of *Platygeomys gymnurus* seen from behind. *a* upper; *b* lower.

Both upper and lower incisors have their anterior faces covered with a plate of enamel, the edges of which are bent back over the sides of the tooth far enough to hold it securely (fig. 20, *a*, *b*, and fig. 24) so that it can withstand, without danger of loosening, the great strain to which it is subjected in cutting hard roots.

On the inner side of the tooth the inflexed border of the enamel is beveled (fig. 20, *a*); on the outer side it retains its normal thickness (fig. 20, *b*). The inner edge of the tooth is squarely angular or nearly so, while the outer edge is always broadly rounded (figs. 20, 21, 22). In the lower incisor the front face of the tooth is always flat or nearly so (fig. 24); in the upper incisor it is flat in *Macrogeomys* and *Heterogeomys* (fig. 20), nearly flat or twice convex in *Cratogeomys* (fig. 21^1 and ^{3}), *Platygeomys* (fig. 21^2), and *Pappogeomys* (fig. $21,^4$); and thrice convex in *Geomys* proper (fig. 22^2 and ^{3}) and *Zygogeomys* (fig. 22^1).

The enamel face of the upper incisor is invariably marked (except in some species of *Thomomys*) by a conspicuous longitudinal groove or furrow, resulting from an infolding of the enamel. A second and much smaller groove is sometimes present also, always near the inner edge of the tooth. The form and position of the grooves vary in the different species; there is also considerable range of individual variation.* Five types of sulcation prevail, as follows:

Bisulcate series:

Principal sulcus on *outer* side of median line .... *Geomys*
Principal sulcus on *inner* side of median line .... *Zygogeomys*

Unisulcate series:

Sulcus median or slightly on inner side of median line; rather broadly open ....*Cratogeomys, Platygeomys, Pappogeomys, Orthogeomys*
Sulcus at junction of inner and middle thirds; usually rather narrow and deep ....*Heterogeomys, Macrogeomys*
Sulcus close to inner side or absent.................................. *Thomomys*

In *Geomys* proper the principal sulcus is decidedly on the outer side, and the small inner groove is about one-fourth or one-fifth the distance from the inner edge to the principal sulcus; it is nearer the inner border in the *tuza* series (fig. 22³) than in the *bursarius* series (fig. 22²).

In *Pappogeomys* there is only a single groove (fig. 21⁴), and it is median or nearly so, as in *Cratogeomys*, and very deep, with the convexities on both sides strongly rounded.

In *Zygogeomys* (fig. 22¹) the principal sulcus is median or slightly on the inner side, and the fine inner sulcus is *on* the convexity of the enamel about one-third the distance from the inner side to the median sulcus. It is not so near the inner side as in *Geomys* proper. In the latter the inner convexity is flatter and the small sulcus is on its inner side instead of on the convexity itself.

In *Heterogeomys and Macrogeomys* (fig. 20) the groove is always far on the inner side and sometimes wholly within the inner third. As a rule it is deeper and more abrupt than in the other genera, and the face of the tooth is flatter.

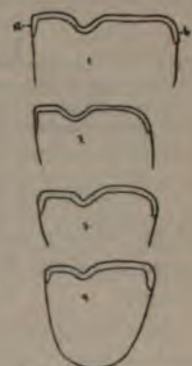

FIG. 20.—Transverse section of upper incisor in the unisulcate species in which the sulcus is strongly on the inner side. (1) *Macrogeomys dolichocephalus*; (2) *Heterogeomys hispidus*; (3) *M. costaricensis*; (4) M. *cherriei* (showing enamel face and single sulcus), *a* inner end of enamel plate; *b* outer end of enamel plate.

In *Cratogeomys and Platygeomys* (fig. 21) the groove, as seen by the

*The exact position of the principal sulcus varies not only in individuals of the same species from the same place, but even on the two sides in the same skull. Thus in *Cratogeomys merriami* and *Platygeomys gymnurus* of the unisulcate series it is usually on the inner side of the median line, but several skulls of each species are at hand in which it is median on one or both sides. Similarly, in *Geomys bursarius* and *tuza* of the bisulcate series, its distance from the outer side of the tooth is sometimes noticeably different on the two teeth. Its exact position therefore can not be relied upon as a character in distinguishing species, though its approximate position is important.

Many of the unisulcate teeth show, when examined closely, a faint inner groove in addition to the deep median furrow. The presence of this indistinct sulcus seems to be purely fortuitous, occurring here and there irrespective of sex, age, or species, sometimes on one side, sometimes on both, and is of no value whatever as a character. Another fortuitous variation is the occasional presence of a fine bead in the median sulcus. When present at all it is rarely symmetrical on the two teeth.

unaided eye, ordinarily appears to be median; but when the tooth is magnified it is nearly always found to lie slightly on the inner side.

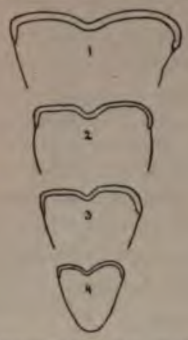

FIG. 21.—Transverse section of upper incisor in the unisulcate species in which the sulcus is median or nearly median—
(1) *Cratogeomys merriami.*
(2) *Platygeomys gymnurus.*
(3) *Cratogeomys perotensis.*
(4) *Pappogeomys bulleri.*

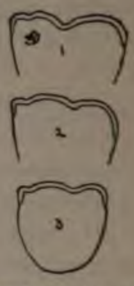

FIG. 22.—Transverse section of upper incisor in bisulcate series—
(1) *Zygogeomys trichopus.*
(2) *Geomys bursarius.*
(3) *Geomys tuza.*

It sometimes differs noticeably in position in the two incisors, and in some specimens of *C. merriami* is further away from the middle than usual.

In *Orthogeomys* the groove is on the inner side, but is usually so widely open that its outer side reaches the median line.

FIG. 23.—Transverse section of upper incisor of *Thomomys douglasi* showing shallow sulcus close to inner side of tooth.

FIG. 24.—Transverse section of lower incisor of *Cratogeomys merriami*; *b*, bevel on outer side.

In *Thomomys* the groove is close to the inner edge of the tooth (fig. 23) or absent. It is usually present, though sometimes very small and shallow. In a few species it is deep and strongly marked, as in *T. monticola* Allen.

The outline of the incisor in cross section varies in the different species. In some forms the antero-posterior diameter exceeds the transverse; in others the transverse equals or exceeds the antero-posterior. Usually the outer side of the tooth is an even curve from the point where the inflexed border of the enamel stops, to the posterior convexity of the tooth, but this is not always the case. In the upper incisor of *Cratogeomys oreocetes*, and the lower of *C. merriami*, the outer side is emarginate, forming a distinct bevel immediately behind the reflexed enamel edge (fig. 24, *b*).

THE PREMOLARS.

The premolars are double prisms, like a figure 8 in transverse section (fig. 25 and pl. 16, figs. 8, 12, and 13). Their crowns are worn obliquely to the axis of the tooth, hence the prisms are of unequal length; the posterior prism is longest in the upper premolar and the anterior in the lower. In size the two prisms of the upper premolar are subequal or the anterior is only slightly smaller than the posterior; in the lower, the anterior is commonly considerably narrower and more elongated anteroposteriorly. In form both prisms of the upper premolar and the posterior of the lower are transversely elliptical like the molars; but the anterior prism of the lower premolar is cylindrical or subcylindrical. Its transverse section is more nearly circular in *Zygogeomys trichopus* and the *Geomys bursarius* series than in the others. In *Macrogeomys cherriei* it is more elongated transversely than usual in the group. The neck connecting the anterior and posterior prisms is usually on or near the median line of the tooth, but in the upper premolar of *Heterogeomys hispidus* it is decidedly on the inner side.

The premolars are larger than the molars, and the lower premolar is the largest of the molariform series (fig. 26). The upper premolar is implanted very obliquely and invariably *slopes* strongly backward from root to crown, the vertical plane of the root being far anterior to that of the crown. The lower premolar is strongly curved; it is always concave anteriorly and convex posteriorly. It is implanted vertically or nearly so, though its root curves forward. The upper premolar is decidedly longer than the lower in the genus *Geomys* (both in *Geomys* proper, comprising the *bursarius-tuza* series, and in the *Pappogeomys bulleri* series); the two are subequal in all the other genera. The shaft of the upper premolar may be either straight or curved. When curved it may be convex forward or concave forward. It is straight in *Geomys lutescens*, but decidedly concave anteriorly in all the other species of *Geomys* proper and in *Pappogeomys* and *Orthogeomys*; it is strongly or moderately convex anteriorly in *Cratogeomys* and *Macrogeomys*, and faintly convex or nearly straight in *Heterogeomys*, *Zygogeomys*, and *Platygeomys*. In the latter genera it is commonly straight in the young and slightly curved in the adult.

FIG. 25.—Crowns of upper and lower premolars of *Macrogeomys dolichocephalus*: *a* upper, *b* lower.

The length of prism of the upper premolar in *G. bursarius*, *tuza*, and *mobilensis* is at least one-third greater than the total length of the tooth row on the crowns (fig. 26³); in *G. texensis* it about equals the length of the tooth row. Various intermediate conditions occur in the other species. The length of the upper premolar with reference to the molars affords two series: (1) in which the premolar and m^1 and m^2 are of about the same length (comprising *G. bursarius* and most of the species in the other genera, fig. 26¹ and ²); and (2) those in which the premolar is decidedly longer than m^1 and m^2 (*G. tuza* and *mobilensis* and *Pappogeomys bulleri*, fig. 26³). The length of the upper and lower premolars with reference to each other also affords two series: In the genus *Geomys* the lower is *much* shorter than the upper (fig. 26[3]); in the other genera (*Cratogeomys*, *Heterogeomys*, and *Zygogeomys*) the two are subequal or the lower is slightly the longer (fig. 26[1] and [2]).

THE MOLARS.

The true molars, except the last upper one (m^3), are simple single tubular prisms, elliptical in transverse section. The last upper molar is a single prism in some forms; a double prism in others. In both upper and lower series the posterior molar is the shortest tooth (fig. 26). In the lower series the teeth are successively shorter from premolar to last molar. In the upper series the premolar may or may not be longer than the first molar; the first and second molars may be subequal or either may be slightly longer than the other. As a rule throughout

FIG. 26.—Types of molariform teeth (seen in profile): *a* upper series; *b* lower series.
1. *Heterogeomys hispidus.*
2. *Cratogeomys merriami.*
3. *Geomys tuza.*

the group, the first and second upper molars are as long or nearly as long as the premolar. This is the case in *Geomys bursarius;* but in other species of *Geomys* proper (*tuza*, *breviceps*, and *texensis*) and in the genus *Pappogeomys* they are very much shorter. In *Pappogeomys bulleri* and the *Geomys tuza* series the longest upper molar is only about two-thirds the length of the premolar, and m^3 is only half as long as the premolar.

In the lower jaw the molariform teeth are successively shorter from before backwards, but diversity prevails in the relative lengths of the several teeth comprising the series. Thus in *Heterogeomys hispidus* m_3 is but little more than half the length of $\overline{pm}$; while in other species it is more than three-fourths. The relative length of the individual molars varies in the different species and is subject to considerable individual variation also.

The last upper molar is always the largest of the true molars. Its prism may be either single or double, or incompletely double; when double it nearly equals the premolar in size of crown, but never in length of shaft. It is invariably the shortest tooth of the upper series, and in some species is as short as the last lower molar. It always curves backwards and the curvature is sometimes so great as to form the arc of a small circle. When a double prism, the posterior prism is always much narrower than the anterior. For purposes of classification m^3 is by far the most important tooth in the skull, its size, shape, form of crown, and enamel pattern furnishing characters of much value, as will be seen later.

The *last lower molar* is ordinarily the shortest tooth in the skull, and is always curved—the concavity posterior. In addition to the curvature, it is implanted obliquely, sloping strongly backward from crown to root, the vertical plane of the root being far behind that of the crown. Its root is also rotated backward and inward, enabling it to lie flat against the inner side of the incisor, which passes between the roots of m_2 and m_3 (fig. 41). Owing to the strong slope of the shaft of m_3, the crown is always truncated very obliquely to the axis of the tooth (fig. 18).

The prisms of the *intermediary molars* in both jaws invariably curve outward, so that their outer borders are concave and inner borders convex. The curvature is stronger in the lower than in the upper series, and strongest in m_2, whose root stands further outward (away from the median line) than any other in the series. The outer borders of the prisms are shorter than the inner borders, hence the open root-ends of the teeth always face obliquely outward. The antero-posterior curvatures of the prisms of the intermediary molars above and below take the same direction in each jaw, but vary in degree in the different genera and sometimes in species of the same genus. All of the superior molars curve backward from crown to root; the inferior intermediary molars curve forward from crown to root. In the genus *Geomys* the antero-posterior curvature of m^1 and m_2 is so slight that their prisms may be described as essentially flat (fig. 26^3). If any curvature is apparent, it is backward in m^1 and forward in m_2, in accordance with the rule. In *Zygogeomys* and *Heterogeomys* the curvatures are slight; in *Orthogeomys* they are marked, and in *Macrogeomys*, *Cratogeomys*, and *Platygeomys* they are very strong, m^1 and m^2 curving strongly backward and m_1 and m_2 strongly forward (fig. 26^1 and ^{2}).

In addition to the curves described, the molar prisms are always more or less twisted on their axes. If the teeth were long enough these twists would result in spiral curves.

The axes of the elliptical crowns of the intermediary molars are in a general way transverse to the axis of the skull; but they rarely stand out at right angles. As a rule they slope obliquely forward or obliquely backward. When the crowns of the upper molars slope backward from the median line the crowns of the lower molars are transverse or slope forward, and *vice versa*. The axis of the crowns of m^1 and m^2 normally slopes backward in *Geomys*, *Pappogeomys*, and *Cratogeomys*; it is normally transverse or slopes forward in *Platygeomys*, *Orthogeomys*, *Macrogeomys*, *Heterogeomys*, and *Zygogeomys*.

VARIATION IN FORM OF LAST UPPER MOLAR.

The form of the last upper molar affords excellent characters. In its simplest type, as in the genus *Geomys* (comprising both the *tuza* series and the *texensis-bursarius* series) it is a single prism and the shape of the crown varies from suborbicular to subtriangular (figs. 27[1] and 33). In *Pappogeomys* (fig. 27[2]) the form of the tooth is similar except that there is a decided emargination on the outer side, anterior to the middle, behind which the prism is abruptly narrower. This is the first step in the formation of the 'heel' or posterior lobe, which is so conspicuous in *Orthogeomys*, *Heterogeomys*, and *Macrogeomys* (fig. 27[6] and [7]).

FIG. 27.—Types of form of crown of last upper molar (m^3).

1. *Geomys breviceps.*
2. *Pappogeomys bulleri.*
3. *Platygeomys gymnurus.*
4. *Cratogeomys estor.*
5. *Zygogeomys trichopus.*
6. *Macrogeomys dolichocephalus.*
7. *Macrogeomys heterodus.*

In the genus *Cratogeomys* the tooth is partly converted into a double prism by a vertical groove on the outer side (fig. 27[4]). This genus presents the widest latitude of individual variation known in the family, indicating that the tooth is in a transition state and has not yet attained a condition of stable equilibrium.

It is much more variable in *Cratogeomys* than in *Platygeomys*. Taking both genera together the crown presents all sorts of intermediate patterns, from a form in which the posterior prism is hardly more differentiated than in *Pappogeomys bulleri*, to forms having this prism produced to such a degree that the superficial resemblance to *Heterogeomys* is marked (fig. 35). But it lacks the stability of form and fixity of enamel pattern characteristic of the members of the latter genus.

The variation is greater in the adult than the young, as would be expected from the increased obliquity of the crown with reference to the axis of the tooth in advanced age, and naturally is most marked in the length and form of the heel. Sometimes in old age the crown is worn so obliquely that the heel actually overhangs, acquiring an exaggerated length very different from its transverse section (as in fig. 28, *d*).

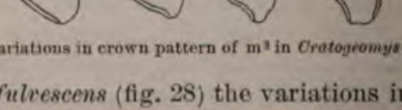

FIG. 28.—Variations in crown pattern of m^3 in *Cratogeomys fulvescens*.

In *Cratogeomys fulvescens* (fig. 28) the variations in form and enamel pattern of crown are pronounced, but most of them are easily reducible to one or the other of two types: (1) An obcordate crown, deeply notched between the prisms on the outer side, with the axis of the posterior loop or heel nearly transverse and the outer enamel plate reduced to a small U-shaped piece protecting the sulcus (fig. 28, *a*); and (2) a more or less subtriangular or even trefoil-shaped crown with the axis of the posterior loop very oblique (sloping strongly backward as well as outward), and the outer enamel plate more or less elongated (fig. 28, *c*, *d*). In form the second is easily derived from the first by a slight backward rotation of the transverse axis of the posterior loop. Regarding the shape of the crown as more or less subtriangular, the apex of the triangle is always toward the median line of the skull and the notch or emargination always on the outer (buccal) side. *Cratogeomys castanops* (fig. 29) stands somewhat apart from the other species. The double character of the prism is not well marked; the posterior part of the crown is rather broadly rounded, the lateral enamel plates are rather short, and the inner one is situated far back. Both tend to disappear in extreme age—doubtless from atrophy of the enamel organ.

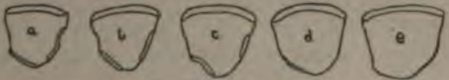

FIG. 29.—Variations in crown pattern of m^3 in *Cratogeomys castanops*.

In the genus *Platygeomys* the crown is subtriangular, narrow behind the anterior prism, and the axis of the heel is normally antero-posterior, as in *Pappogeomys* (fig. 27³).

In *Macrogeomys*, *Heterogeomys*, and *Orthogeomys* (fig. 34), the tooth is a double prism, the anterior and posterior moieties of which are separated by a groove or depression on each side—that on the outer side being invariably the deeper, that on the inner side being in rare cases obsolete. The posterior prism is always narrower than the anterior (the narrowing is chiefly on the outer side), and its antero-posterior diameter is usually greater. The crown as a whole is thus longer than broad, and is composed of two parts or lobes: an anterior which is broader than long (being transversely elliptical, like the other molars); and a narrow posterior lobe or 'heel' which is commonly longer than broad, and varies in form and proportions in the different species.

In *Heterogeomys* the grooves on the two sides are nearly opposite, and the anterior prism is narrowly elliptical. In *Orthogeomys* and *Macrogeomys* the sulcus on the inner side is commonly decidedly posterior to the plane of the outer sulcus. In *Macrogeomys* the anterior prism is broadly elliptical, and the posterior is elongated antero-posteriorly. In *Macrogeomys heterodus* the posterior lobe or heel is very long and slopes obliquely outward; the inner face of the tooth as a whole is unusually flat (fig. 27⁷).

In *Zygogeomys* the last upper molar is an imperfect double prism, the depression on the inner side being slight, while that on the outer side is much deeper. The crown as a whole is longer than broad, and the posterior loop or heel ends in a broad lip-like extension not protected by enamel and hence subject to change of shape by wear (see fig. 27⁵),

ARRANGEMENT OF THE ENAMEL.

After the enamel cap of the newly born young has been ground down far enough to expose the upper ends of the cement bands, the arrangement of the enamel remains the same throughout the life of the individual and affords excellent generic and in some cases specific characters. The enamel never envelops the prism in a continuous sheet, but is deposited in the form of vertical plates or bands which always alternate with bands of cement. These bands are disposed in a definite manner on each tooth of the series. In the under jaw the number in each tooth is the same throughout the group; in the upper jaw the number varies in the several genera.

Premolars.—The permanent *upper* premolar has three enamel plates (one anterior and one lateral on each side*) in the genera *Geomys* proper, *Pappogeomys*, *Cratogeomys*, and *Platygeomys*—the posterior being altogether absent (fig. 30¹). In *Zygogeomys*, *Heterogeomys*, *Macrogeomys*, and *Orthogeomys* the number is increased to four by the addition of a posterior plate, which, however, never covers more than half of the posterior face of the posterior prism, and is always restricted to the inner or lingual side (fig. 30² c). In *Orthogeomys* the posterior plate is sometimes obsolete. The permanent lower premolar always has four enamel plates, the posterior being invariably present and covering the whole hinder face of the tooth (fig. 25, *b*, and fig. 32).

FIG. 30.—Types of enamel pattern of upper premolar.
(1) *Cratogeomys merriami*;
(2) *Heterogeomys hispidus*; (*a*) anterior enamel band; (*b*) lateral band; (*c*) posterior band.

First and second upper molars.—In the first and second upper molars, which are simple elliptical prisms, the normal number of enamel plates is two, one covering the anterior, the other the posterior face of the tooth, with a narrow interval filled with cement at each end between them (fig. 31¹). In many species, however, the posterior plate is obsolete (fig. 31²). It is present and covers the whole hinder side of the tooth in *Geomys*, *Pappogeomys*, *Macrogeomys*, *Heterogeomys*, and *Orthogeomys*. It is present but restricted to the inner or lingual half of the tooth in *Zygogeomys* (fig. 31³), and is altogether absent in *Cratogeomys* (fig. 31²) and *Platygeomys*.

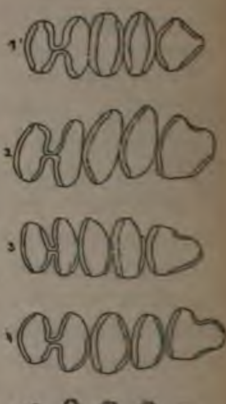

FIG. 31.—Types of enamel pattern of upper molariform series in the different groups:
1. *Geomys bursarius*.
2. *Cratogeomys castanops*.
3. *Zygogeomys trichopus*.
4. *Macrogeomys cherriei*.
5. *Thomomys bulbivorus*.

*In both upper and lower premolars the anterior enamel plate is convex forward; the lateral are strongly bent, conforming to the sulcus between the prisms and extending from the convexity of one to that of the other. The resulting shape in transverse section is usually like that of the letter U, with the opening directed outward and the base resting on the median line of the tooth.

Last upper molar.—Throughout the *Geomyidæ*, except in *Thomomys*, the last upper molar has three enamel plates—one anterior, one on the inner side, and one on the outer side, with interspaces (cement bands) of varying breadth between (fig. 27). In *Orthogeomys scalops* the outer plate is normally divided (fig. 62). The anterior plate always covers the whole front face of the tooth, and is the same in all species; the two others vary in length and shape, and furnish excellent characters. In *Thomomys* there are but two plates, an anterior and a posterior (fig. 31[5]).

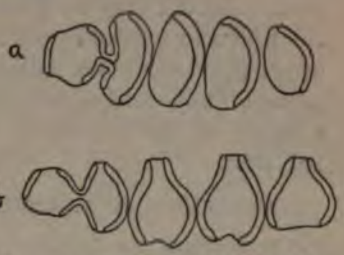

FIG. 32.—Crowns of lower molariform series: (*a*) *Geomys bursarius*; (*b*) *Thomomys bulbivorus*. Except in *Thomomys* (*b*) the enamel pattern is the same throughout the family (as in *a*).

Lower molars.—Except in *Thomomys*, the lower molars have each but a single enamel plate; it completely covers the posterior face of the tooth, the anterior face and sides being covered with cement (fig. 32, *a*). In *Thomomys* each lower molar has two enamel plates, an anterior and a posterior (fig. 32, *b*).

PRINCIPAL DIVISIONS INDICATED BY THE ENAMEL PLATES.

The foregoing study of the enamel plates shows that all of the 37 species and subspecies herein described, and all the species of *Thomomys*, may be arranged in five principal groups, according to the presence, absence, or relations of the posterior enamel plate in the upper molariform series, as follows:

1. Posterior enamel plate absent in *pm* and present in m^1 and m^2 .... *Geomys*, *Pappogeomys*, *Orthogeomys*.*
2. Absent in both *pm* and m^1 and m^2 .... *Cratogeomys*, *Platygeomys*.
3. Present on inner (lingual) side in both *pm* and m^1 and m^2 .... *Zygogeomys*.
4. Present on inner (lingual) side in *pm* and complete in m^1 and m^2 .... *Heterogeomys*, *Macrogeomys*, *Orthogeomys*.*
5. Present in *pm* and m^1, m^2, and m^3 .... *Thomomys*.

NORMAL NUMBER OF ENAMEL PLATES—SUMMARY.

The number of enamel plates actually present in the different teeth has been shown to vary from one to four. The number on each tooth has been found constant in the lower series; inconstant in the upper series. The lower premolar (which is a complete double prism) invariably has four, and the lower molars one each, except in *Thomomys* in which they have two (fig. 32). The upper premolar (a complete double prism) has four in some genera; three in others. The upper intermediary or elliptical molars (m^1 and m^2) have two in some genera; one in

* *Orthogeomys* is losing the posterior enamel plate of the upper premolar. It is present in *O. latifrons*, but greatly reduced or altogether absent in *nelsoni* and *scalops*.

others. The last upper molar (an incomplete double prism) invariably has two in *Thomomys* and three in all the other genera. These facts indicate that the normal number of enamel plates in simple elliptical prisms is two, and that one has been suppressed in all of the elliptical molars having only one (the lower molars in all except *Thomomys* and the first and second upper in *Platygeomys* and *Cratogeomys*), and in the upper premolar when it has only three plates (as in *Platygeomys*, *Cratogeomys*, *Pappogeomys*, and *Geomys* proper). This view is supported by a study of the mechanics of the grinding process. (See pp. 90-97, 107-108).

VARIATIONS IN ENAMEL PLATES OF LAST UPPER MOLAR (m^3).

Throughout the family, except in *Thomomys*, the last upper molar is strengthened by three vertical plates or bands of enamel, alternating with three interspaces filled with cement (figs. 33, 34). The anterior of the three enamel plates is constant in form and relations; the two others inconstant. The anterior invariably covers the whole front face of the tooth and is convex forward (the convexity may be slight or great). The others vary in position, shape, and relative breadth. In a single species, *Orthogeomys scalops*, the outer plate is normally divided (fig. 62). In the simplest forms, in which the tooth is a subcylindric or subtriangular prism, as in *texensis*, *breviceps*, and allied species (fig. 33), they are simple vertical bands of enamel, subequal in size, one on

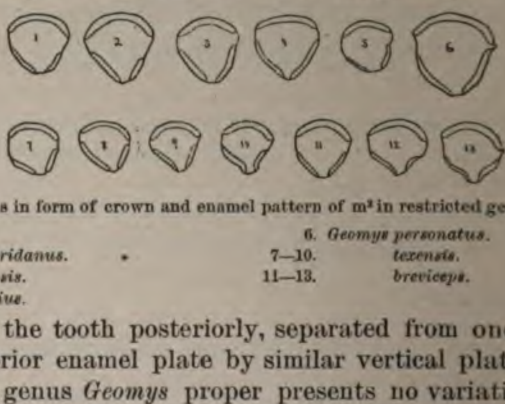

FIG. 33.—Variations in form of crown and enamel pattern of m^3 in restricted genus *Geomys*.

1, 2. *Geomys tuza*.
3. *tuza floridanus*.
4. *mobilensis*.
5. *arenarius*.
6. *Geomys personatus*.
7—10. *texensis*.
11—13. *breviceps*.

either side of the tooth posteriorly, separated from one another and from the anterior enamel plate by similar vertical plates or bands of cement. The genus *Geomys* proper presents no variations from this type except in the relative breadth of the inner (lingual) and outer (buccal) enamel bands. The inner is more constant than the outer and is commonly somewhat broader.* Sometimes the two tend to define a lip posteriorly (fig. 33[10] and [13]). Marked departures from this simple type occur in those species in which the last upper molar is a double instead of a single prism; and since various intermediate conditions in

*In *G. tuza* the outer plate is much narrower or shorter than the inner. Since the teeth are commonly looked at endwise from above, the enamel pattern is ordinarily seen in transverse section, and the three enamel plates appear as narrow bands on the periphery of the prism. Their *breadth* on the sides of the tooth is shown in the *length* of the band as it appears on the crown. In describing the pattern, therefore, it is convenient to use the term *length* instead of *breadth* to designate the relative width of the vertical enamel plates.

the evolution of the double prism are presented by living species, so the several stages in the adaptation of the lateral enamel plates to the development of a posterior loop or heel are clearly shown. These changes consist in a lengthening or shortening of the enamel plate (as it appears on the crown of the tooth) and in the development of a bend or flexure by virtue of which the enamel conforms to the curvature of the anterior and posterior loops, resulting from the development of a deep sulcus on one or both sides of the tooth in those species that have a double prism. And since the sulcus on the outer side appears first and is always deepest, it follows that the outer enamel plate is the one most affected and shows the greatest range of variation (fig. 34).

Outer (buccal) enamel plate.—The first step in the formation of a distinct and permanent flexure may be seen in *Pappogeomys bulleri* (fig. 34, [1]), in which species the anterior end of the outer enamel plate bends

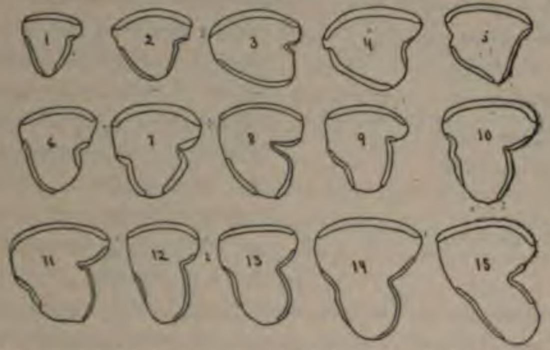

FIG. 34.—Forms of crown and enamel pattern of m^3 in the genera in which this tooth is a double prism.

1. *Pappogeomys bulleri.*
2. *Platygeomys gymnurus.*
3. *Cratogeomys estor.*
4. *oreocetes.*
5. *peregrinus.*
6. *Zygogeomys trichopus.*
7. *Orthogeomys latifrons.*

8, 9. *Orthogeomys nelsoni.* 8. *Totontepec*; 9. *Comaltepec.*
10. *Heterogeomys hispidus.*
11. *torridus.*
12. *Macrogeomys cherriei.*
13. *costaricensis.*
14. *dolichocephalus.*
15. *Macrogeomys heterodus.*

outward in front of the vertical sulcus that marks the outer side of the tooth. A slightly more accentuated condition is found in *Platygeomys gymnurus* (fig. 34, [2]). The extreme development of this flexure is attained in the genera *Heterogeomys* (fig. 34, [10] and [11]), *Macrogeomys* (fig. 34, [13], [14], [15]), and *Orthogeomys* (fig. 34, [7] and [8]), in all of which the bend is essentially a right angle—a result of the deepening of the sulcus between the prisms. At the same time the posterior arm of the enamel plate is considerably lengthened in order to protect the elongated posterior lobe or heel to which it conforms. In *Orthogeomys* and all the known species of *Heterogeomys* and *Macrogeomys* the posterior limb is about double the length of the anterior; and except in *M. heterodus* it actually reaches the hinder border of the tooth. In *Orthogeomys scalops* a very remarkable condition prevails; the outer enamel plate is normally divided (fig. 62).

In *Platygeomys* the outer enamel band is normally either straight or bent outward at the extreme anterior end—not U shaped as in *Cratogeomys* proper.

In the remaining groups a widely different condition obtains: The outer enamel plate is much reduced, and as a rule the two arms are subequal. This type prevails in *Cratogeomys* proper and in *Zygogeomys*—groups whose interrelations are distant and obscure. In *Cratogeomys* the outer plate is normally (?) reduced to a mere angle or U-shaped piece at the bottom of the sulcus that gives the outer side of the tooth the semblance to a double prism (fig. 35, [5] and [6]), leaving a wide unprotected interval (cement band) on each side. It is variable, however, and in some specimens the posterior arm reaches nearly to the end of the heel (fig. 35, [8]). The difference may be sexual; but owing to the difficulty in determining the sex in these animals, which difficulty is greatly increased in the case of the young, it is unsafe to place much reliance on the sex marks accompanying the specimens. Still there is reason for suspecting that those specimens in which the outer plate is elongated posteriorly are females. The variation is much greater in some species than in others. It is most extreme in *C. castanops* (fig 29), and least, so far as our material goes, in *C. perotensis* and *estor*. In advanced age it sometimes happens that the lateral enamel bands become abnormally short on one or both sides and very rarely become divided in the middle. Accidents of this sort are probably the result of shrinkage or atrophy of the enamel organ.

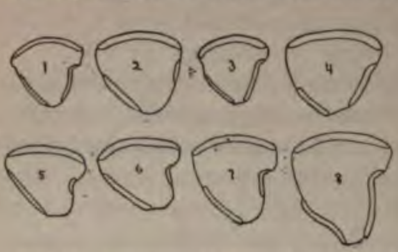

FIG. 35.—Variations in form of crown and enamel pattern of m^2 in *Platygeomys* and in *Cratogeomys merriami*.

1, 2. *Platygeomys gymnurus*.
3. *Platygeomys tylorhinus*.
4. *Platygeomys fumosus*.
5–8. *Cratogeomys merriami* (all from Amecameca, Mexico).

In the genus *Zygogeomys* the outer angle is more open and the enamel plate covers about half of the outer side of the tooth.

The outer enamel plate is slightly longer than the inner in *Platygeomys*, and much longer in *Heterogeomys*, *Orthogeomys*, and *Macrogeomys* (except in *M. heterodus*); it is subequal or shorter in all the other known forms.

Inner (lingual) enamel plate.—The inner plate is much less variable than the outer, as previously stated. It is straight or slightly convex, except in the few species that have a real sulcus on the inner side, converting the tooth into a complete double prism. In these its anterior part curves or bends outward. This condition is known in the three genera, *Heterogeomys*, *Macrogeomys*, and *Orthogeomys*. In *Heterogeomys* the outward curvature is slight (fig. 34, [10] and [11]); in *Macrogeomys dolichocephalus* and *Orthogeomys latifrons* it is strong (fig. 34, [14] and [7]). In length and position the inner plate is much more variable: It reaches the hinder end of the tooth in *Geomys* proper, *Cratogeomys*, *Pappogeomys*, *Platygeomys*,* *Zygogeomys*, and *Orthogeomys;* falls slightly short of the end in *Macrogeomys*, and very considerably short in *Heterogeomys*. In *Heterogeomys* it barely covers half of the inner side of the tooth; in all the other known species it covers nearly two-thirds or more than two-thirds of the inner side. The condition in *Heterogeomys* therefore is clearly exceptional.

CHARACTERS OF THE UNWORN TEETH.

Specimens of pocket gophers young enough to show the deciduous premolars and the unworn crowns of some of the molars are so exceedingly rare that I have seen but four in the entire series of specimens of this genus examined in the preparation of the present paper. Two of these are *Geomys bursarius* from Elk River, Minn., collected by Vernon Bailey April 29, 1888, and May 14, 1886 (Nos. 4909 and 2927, Merriam collection); the third is a young *Geomys mobilensis* from Milton, Florida. The fourth is a juvenile specimen of *Heterogeomys torridus* from Motzorongo, Mexico, collected by E. W. Nelson March 5, 1894 (No. 63643, U. S. N. M.). The unworn teeth are so much alike in the two genera that they may be described together.

Incisors.—In both genera the grooves in the front face of the upper incisors are very much deeper and larger than in the adult, and the convexities are much more strongly rounded. In the young of *Geomys bursarius* the two grooves do not present the disproportion characteristic of the adults, the small inner groove being relatively much deeper and larger, though by no means so large as the median groove.

Deciduous premolars.—The crown of the upper deciduous premolar is much elongated and has an anterior prism in addition to the double prism of the permanent tooth (pl. 16, figs. 1 and 3). The double prisms are united on the inner (lingual) side, forming a U-shaped grinding surface (with the opening directed outward) in front of which, separated by sulcus, is the small transversely elongated summit of the anterior prism. The crown of the lower deciduous premolar is likewise much elongated, and it is irregularly and incompletely divided into three lobes (pl. 16, figs. 2 and 4*b*). Both upper and lower premolars have the anterior and posterior roots far apart, and the permanent premolar may be seen between them (fig. 36, and pl. 16, figs. 1–4, *a*).

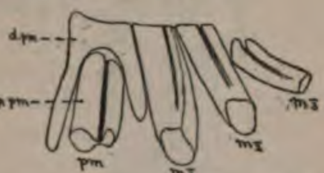

FIG. 36.—Lower molariform teeth of a very young *Geomys bursarius*, showing deciduous and permanent premolar in situ, and unworn crown of m_3 which has not yet reached the plane of the crowns of the other teeth.

*In *Platygeomys fumosus* the inner enamel band seems to be normally shorter than the outer, and only half or less than half the length of the anterior band (fig. 35[4]).

Permanent premolars.—One of the upper deciduous premolars (pl. 16, fig. 1*b*) has been removed from the baby skull of *Heterogeomys torridus*, exposing the unworn crown of the permanent premolar (pl. 16, fig. 1*x*). The permanent premolar also has been removed and figured in several positions to show the form, size, and relations of its primitive enamel cap (pl. 16, figs. 5, 6, and 7). For ready comparison, the corresponding tooth in an adult of the same species has been figured also (pl. 16, fig. 12). On reference to pl. 16 it will be seen not only that the crown of the young premolar is completely enveloped with enamel, but that the enamel cap reaches down over the shaft of the double prism, covering nearly half of the tooth (figs. 5, 6, and 7) and passing continuously into the four enamel bands that alone remain in the adult (fig. 12*). The fact that the young of the various species as usually obtained rarely show any trace of the enamel cap indicates that the growth of the young teeth and grinding down of the crowns progress with surprising rapidity. A very young *Cratogeomys castanops* from Las Animas, Colo., collected by Dr. A. K. Fisher, has only a remnant of the enamel cap left (pl. 16, fig. 14).

The unworn crown of the *upper* premolar (pl. 16, figs. 1 *x*, 5, 6, 7) has a single transverse crest on the anterior prism, an incompletely double transverse crest on the posterior prism, and an oblique ridge connecting the two on the inner side. The single crest of the anterior prism is notched or bifid at the apex, and has a small upright lobule at the base of the notch on the inner side. The double crest of the posterior prism is open on the outer side, and the crest as a whole is roughly and narrowly U-shaped. The summit of the anterior crest is bilobate; that of each arm of the posterior crest is irregularly trilobate or trituberculate.

FIG. 37.—Right lower unworn permanent premolar of *Heterogeomys torridus:* (1) inner or lingual side; (2) enamel cap from above; *c*, cement bands; *e*, enamel; *eo*, enamel organ.

The enamel cap of the permanent *lower* premolar is a complete double prism, each moiety of which bears an independent transversely elongated crest (fig. 37). The summit of the anterior crest (fig. 37²), is trituberculate; that of the posterior is incompletely double, being split lengthwise into two unequal parts, the posterior of which is the shorter and more irregular. The trituberculate crest of the anterior prism is bilaterally symmetrical. There are two large tubercles or lobes, one on each side, and a smaller median one, which is much elongated antero-posteriorly and is continuous with the ridge connecting the anterior and posterior prisms.

*In figs. 5, 6, 7, and 12 the cement bands are shaded, thus serving to bring out the enamel more distinctly.

Molars.—In all of the young skulls under consideration the deciduous premolar and the intermediary molars (m 1 and 2) have been used, and their enamel caps have been partly ground down, while the permanent premolars and last molars have not yet suffered attrition. The *premolar* has been already described. The enamel cap of the *last lower molar*, which has not yet reached the plane of the crowns of the other teeth (fig. 38 and pl. 16, figs. 2, *d*, 4, *d*, and 9, *d*), presents two complete transverse crests, each of which has an undulating summit incompletely divided into three lobes. The two crests are separated by a deep furrow and show no tendency to come together at any point. The enamel cap covers a little more than half of the tooth (fig. 38, *e*). The *last upper molar* (pl. 16, figs. 1, *c* and 3, *c*) has just reached the level of the other teeth. Its unworn crown in both genera presents a well-defined anterior and a less distinctly defined posterior crest, separated by an interspace which is bridged over by an oblique enamel ridge on the inner side of the median line. The anterior crest is incompletely trilobate. The posterior crest is thickened and less symmetrical than the anterior, and in *Heterogeomys torridus* (pl. 16, fig. 1, *c*) it is incompletely double, being partly divided by a transverse excavation.

FIG. 38.—Right last lower molar of very young *Heterogeomys torridus* (from same specimen as fig. 37); inner or lingual side, showing unworn enamel cap, and relations of enamel and dentine lower down: *c*, cement bands; *e*, enamel; *eo*, enamel organ.

The crowns of the first and second upper molars present different degrees of wear in the three young specimens at hand, and none of them are young enough to show the transverse crests by which they were undoubtedly crowned before the tops of their enamel caps were ground down. The wearing, however, has not progressed so far as to obliterate the double crowns characteristic of immaturity except in the upper molars of one specimen of *G. bursarius* (No. 4909). In the other skull of this species (No. 2927) a transversely elongated loop of enamel incompletely divides the grinding surface of m^2, indicating the former presence of two transverse loops, as in the lower molars. In the lower series the double crowns are well shown in both *Geomys bursarius* (pl. 16, fig. 4) and *Heterogeomys torridus* (pl. 16, fig. 2). In one skull of *Geomys bursarius* (pl. 16, fig. 4) the second lower molar is only slightly worn, and its crown presents two transverse loops separated by a decided depression. In the other skull it is more worn, but still is incompletely divided. The crown of the first lower molar in both skulls is deeply notched on the inner side and slightly on the outer, showing that when unworn it resembled the others.

Summary.—The summits of the unworn molariform teeth in *Geomys* and allied genera are not only completely covered with enamel, but the enamel cap is complicated by crests and tubercles. The permanent premolar, which is a double prism, has a single transverse crest over the anterior prism and a partly double crest over the posterior. The true molars are bilophodont, each carrying two transverse crests. In the case of the last upper molar, the posterior crest is thickened and somewhat irregular and may represent the coalescence of two crests. It is joined to the anterior by an oblique ridge on the inner side. In the premolar and last molar, above and below, the summit of each crest is more or less distinctly divided into two or three lobes or tubercles. There is every reason to believe that the crowns of the intermediary molars (m [1] and [2]) are similarly crested-tuberculate when in the unworn condition, but in the specimens at hand their summits are worn down too far to show it.

The crowns of the unworn teeth are bilophodont in all the lower molars and in the first and second upper molars. The premolar and last upper molar (m [3]) may be considered as imperfectly trilophodont, the posterior prism in each instance being incompletely double.

The theory that permanently rootless teeth with flat grinding crowns are more primitive and less specialized than rooted teeth with tuberculate crowns receives a decided setback in the circumstance that the young unworn molars in the *Geomyidæ* are provided with crested-tuberculate enamel caps, and that the adult teeth, though simple when considered singly as individual prisms, constitute, when taken collectively, one of the most highly specialized grinding and cutting machines thus fardiscovered.

CHANGES IN FORM AND ENAMEL PATTERN OF YOUNG TEETH RESULTING FROM WEAR.

As already stated, the bilophodont crowns of the embryo and very young molars are hardly ever seen, the wearing down of the primitive enamel cap proceeding so rapidly that the youngest specimens ordinarily coming under the eye of the naturalist have flat grinding surfaces as in the mature animal. During the reduction of the young crown four different types of enamel pattern, representing as many stages of wear, succeed one another as follows:

First stage (before the crests are completely obliterated): *two parallel disconnected transverse loops.*

Second stage (when the sulcus between the crests is reached): *a figure 8.*

Third stage (after the sulcus is passed and before the tops of the cement bands are reached): *a continuous ring or circle.*

Fourth stage (after the tops of the cement bands are reached): *the pattern of the mature tooth*, consisting of from one to three bands of enamel alternating with the same number of bands of cement, as already explained in detail.

The first stage is of brief duration; the second still more evanescent; the third decidedly longer than the first and second together; the fourth continues throughout the life of the animal.

During the early part of the fourth stage the form of the shaft of the tooth changes, the double prism characteristic of extreme youth giving place to the single elliptical prism of the adult (except in the last upper molar, which in some genera remains permanently double). It seems remarkable that a tooth having a large double crown like the first and second lower molars of the very young animal (pl. 16, figs. 2 and 4) should be capable of changing its form to that of the single transverse ellipse of the adult (pl. 16, fig. 17) in a very brief period and without molting the tooth. That it does so is not open to question, and may be demonstrated by making a section of the lower part of the young tooth. This has been done in the case of the second lower molar, as shown in pl. 16, fig. 4, where 4*x* is a transverse section of the same tooth from the lower fourth. The antero-posterior diameter of the tooth decreases from above downward and the vertical groove on each side becomes shallower and shallower and finally disappears. The change in the shape of the crown takes place naturally by the rapid wearing down of the grinding surface, which brings successively lower parts to the top.

THE ENAMEL ORGAN.

Throughout the group the enamel organ is situated at the base of the teeth, as usual in rodents having prismatic molars. In the young tooth the enamel organ is very much larger than in the adult, owing doubtless to the greater rapidity of growth in early life. Thus on referring to pl. 16 (figs. 5, 6, and 7) it will be seen that the enamel organ occupies about one-fifth of the length of the upper premolar in a very young animal, while in the corresponding tooth of an adult of the same species (fig. 12) it occupies only about one-fifteenth of the length of the tooth. In extreme age partial atrophy of the enamel organ sometimes takes place, causing a shortening of the enamel on that side. In a few instances an enamel plate has been found divided in the middle, due doubtless to atrophy or injury of the enamel organ in the same vertical plane.

OSTEODENTINE.

A core of osteodentine traverses the central part of each tooth. In the premolars and all of the molars except m^3 it forms a large elliptical shaft in the middle of each prism. In m^3, whether single or double, the osteodentine is a single core, conforming in shape to the shape of the tooth. On all sides it passes into the true dentine, by which it is completely enveloped except at the free ends. At the lower end it passes insensibly into the growing pulp. In other words, the osteodentine is a central core consisting of the hardening pulp and containing the vessels by means of which the tooth is nourished. In the *Geomyidæ* it forms a considerable part of the substance of the tooth, as usual in prismatic teeth growing from persistent pulps. In the genera *Geomys* and *Cratogeomys* it is pale buffy or yellowish brown in color, and consequently not conspicuous. In the genera *Heterogeomys* and *Zygogeomys* it is dark brown, in striking contrast to the white of the rest of the tooth.

MECHANISM AND DYNAMICS OF THE CUTTING MACHINE AS A WHOLE.

The individual teeth have been described. It remains to consider them as parts of a complex and highly specialized mechanism for cutting and slicing the food, to describe the muscles that operate the machine, to mention other structures concerned in the act of mastication, and to show how a bit of root or other hard vegetable tissue is cut loose, sliced, and reduced to pulp ready to pass into the stomach.

The primary object of the dental armature is twofold: (1) To enable the animal to bite or chisel off pieces of the hard vegetable substances on which it feeds, and (2) to reduce these pieces to a condition of minute subdivision suitable to be turned over to the stomach for digestion. The incisors serve the additional purpose of bars, axes, and picks in helping the animal overcome the various obstacles encountered in driving its tunnels through different soils. When the front teeth are used for this purpose, the resulting dirt and chips are kept out of the mouth proper by a furry partition, elsewhere described, which divides the mouth as a whole into two chambers.

MANNER OF ATTACHMENT OF THE TEETH.

The way the teeth are fastened in their sockets is in harmony with the other remarkable adaptations of the grinding apparatus. The attachment is effected by means of the periosteum of the alveolus, which does not invest the teeth, but is firmly adherent to the cement bands, leaving the enamel faces free. Thus each tooth is suspended by one or more vertical cushions, which extend all the way from root to gum. This method of attachment not only relieves the tender pulp at the base of the tooth from pressure, but gives to the cutting edge or edges an elasticity that must be highly effective. In the case of the incisors, the area of attachment is very extensive, comprising the whole of the tooth below the gum except the enamel face. The lower molars throughout the entire group, and the intermediary upper molars in the genus *Cratogeomys*, are attached in the same way on one side only—the side opposite to the enamel or cutting edge. In the case of the upper premolars the principal attachment is along the posterior face of the posterior prism, while a supplementary band on each side of the anterior prism serves to keep the cutting edges always in place. In those species in which the posterior prism of the upper premolar develops an enamel band on its inner or lingual side, the tooth is suspended by four cement bands. The lower premolar is attached by four narrow lateral bands. The last upper molar is invariably held firmly in place by three cement bands, one on each side anteriorly and one on or near the median line behind.

DYNAMICS OF THE INCISORS.

The upper incisor has been shown to curve in the arc of a circle, to cover a little more than a complete semicircle, and to lie in a single plane (figs. 18 and 19). Its root is very long with relation to the length of the muzzle, always overreaching the first upper molar. It is implanted in such manner that its cutting edge is directed downward and slightly backward. The lower incisor has been shown to curve outward in an incomplete spiral, and to traverse the entire length of the mandible—its root projecting on the outer side of the condylar process, where it is incased in a thin capsule of bone. This small capsule contains the pulp from which the tooth continually grows to replace the wear at the other end. The extreme development of these teeth is proportionate, of course, to the strain put upon them in chiseling hard roots. The upper incisor is subjected to less strain than the lower, and its principal function seems to be to anchor the cutting machine to the substance operated on, while the greatly elongated lower incisor does most of the work. The free end of the lower incisor slopes forward and upward, its angle of implantation being different from that of the upper. Thus, while the upper incisor remains stationary, its recurved and usually divided tip enabling it to hold fast to the object to be cut, the lower incisor plays rapidly back and forth like a steam drill, its straight enamel edge doing the cutting.

The great length of the incisors within the alveolus is necessary in order to counterbalance the length of the part that protrudes beyond the jaws, and also to afford a large surface for attachment within the alveolus so as to relieve the growing root from pressure. The way the teeth are attached to the jaw by a long belt or cushion, which envelops all but the enamel face, gives to the cutting edge an elasticity that must be of great service, not only in increasing the efficiency of the act of chiseling, but also in relieving the tooth from jar.

It remains to notice the interesting secondary modifications of the skull and molariform teeth, by means of which the animal is enabled to open the front part of the mouth wide enough to use the incisors to advantage. The molariform teeth stand much higher out of the jaw anteriorly than posteriorly, and their roots increase in length proportionally (fig. 18). The premolars, both above and below, protrude twice or more than twice as far as the last molars. Thus, when the mouth is shut and the teeth pressed firmly together, the jaws are at least twice as far apart at the anterior as at the posterior end of the molar series. Now, the distance from the crown of the premolar to the cutting edge of the upper incisor is two and one-half to three times the length of the molariform series on the crowns, and the axis of the skull is nearly parallel to the plane of the crowns of the molar teeth. Hence, without any other help and with the mouth shut, the ends of the jaws (where the incisors cut the gums) would be from five to six times farther apart than at the plane of the posterior molars.* This arrangement permits the necessary protrusion of the incisors, the cutting edges of which, as a rule, reach the plane of the crowns of the molars in the upper jaw and slightly pass this plane in the lower jaw. The great advantage of this arrangement is most apparent during the act of biting off hard roots, when a very slight opening of the mouth proper, entailing only a slight separation of the molars, is sufficient (multiplied along the length of the strongly divaricating jaws) to separate the chisel ends of the incisors widely, enabling them to grasp objects of comparatively large size.

DYNAMICS OF THE MOLARIFORM TEETH.

(*a*) *Manner of implantation and curvatures.*

The angle of implantation of the molar series as a whole in both upper and lower jaws is peculiar. A transverse section of the skull (fig. 39) shows that the roots of the upper molars are nearer the median line than the crowns.† It follows that the upper tooth rows are strongly *divergent* from root to crown (fig. 39, *e*). In the lower series the converse occurs, the tooth rows *converging* from root to crown (fig. 39, *f*). The upper molars slope strongly and curve moderately outward from root to crown, while the lower molars both slope and curve strongly outward from crown to root.

The crowns of the opposing series do not meet in a horizontal plane, but are obliquely truncated: the upper series face obliquely *downward and outward;* the lower series obliquely *upward and inward* (fig. 39). When the jaws are shut, lateral movement in a horizontal plane is impossible. If a circle is drawn around the upper molars (fig. 40) it is at once apparent that during the lateral movement of the mandible the crowns of the teeth move sideways in the arc of a circle, thus giving the utmost possible mechanical advantage. The axis of rotation is in or near the basicranial axis, and the axis or arc of oscillation is short, as in a pendulum. To enable the teeth to withstand the great pressure to which they are thus subjected, they have developed very long roots

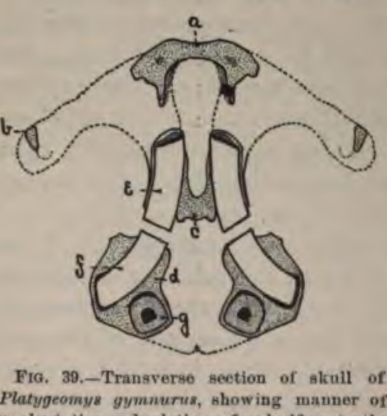

FIG. 39.—Transverse section of skull of *Platygeomys gymnurus*, showing manner of implantation and relations of molariform teeth. *a*, Frontal; *b*, zygoma; *c*, palate; *d*, mandible; *e*, upper molar; *f*, lower molar; *g*, incisor.

* The actual condition is not exactly as here described. In the case of the lower jaw the distance is *decreased* by the upward curvature of the anterior end of the jaw and the shortening of the diastema. In the upper jaw it is *increased* by the excavation of the under side of the rostrum between the molars and incisors.

† The roots of the upper premolars are even nearer together than those of the molars; *they are, in fact, almost in contact.*

l a system of complex curvatures and oblique implantations, and suspended in their sockets by vertical bands of periosteum, as eady described. When the jaws are shut, the molars on each side ve outward so strongly that the distance be en them below (between roots of lower series) everal times greater than above (between roots upper series). The result of this arrangement hat the molar teeth, during the lateral move- nt of the act of grinding the food, press upon opposing series not only in such manner as to ure the greatest mechanical advantage, but so as to produce the least jar, since the press- in both directions is distributed over arcs of les. But this is not all, for if the tooth rows viewed from the side another remarkable plex of curvatures appears (figs. 18 and 26).

FIG. 40.—Upper and lower molars of *Platygeomys gymnurus* in normal position, showing angle of truncation of crowns, necessitating lateral movement in arc of circle.

is now seen that in addition to the lateral curvatures there are ngly developed antero-posterior curves and incomplete spiral ves. In the upper series the premolar always slopes strongly ward, and the molars curve backward from crown to root. In the er jaw the premolar and intermediary molars (m_1 and m_2) curve for- rd from crown to root and the posterior molar backward. The er premolar is the largest and heaviest tooth of the molariform ies; it is strongly concave forward, convex backward, and is im- nted nearly vertically. The last molar is the smallest tooth, and h slopes and curves strongly backward from crown to root. The teeth of each series thus act as braces to support the tooth row as hole during the antero-posterior movement of the jaws in grinding, to keep the molars constantly 'keyed up,' so preventing any tend- y to spacing between the crowns.

n addition to the curvatures described, molariform teeth are usually more or twisted spirally on their vertical axes, hat the two ends lie in different tan- tial planes. Furthermore, the outer ncave) edge is commonly shorter than inner (convex) edge.

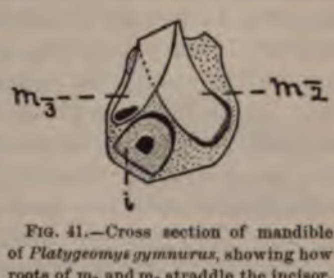

FIG. 41.—Cross section of mandible of *Platygeomys gymnurus*, showing how roots of m_2 and m_3 straddle the incisor.

he molariform teeth are so implanted t the roots of each lateral series, above below, lie in at least two antero- terior planes, the roots of the premolar and last molar in both jaws ng nearer the median line of the skull than those of the intermedi- molars. The discrepancy is most marked in the lower series, where posterior lower molars (m_2 and m_3) actually straddle the root of the sor (fig. 41). The roots of m_1 and m_2 curve down outside (on the cal side) of the incisor, while that of m_3 lies on its inner (lingual) . In order to do this the latter tooth (m_3) not only curves strongly backward but is twisted on its own axis sufficiently to enable its root to lie flatwise against the inner side of the incisor.

(*b*) *Influence of the direction of the jaw movement on the molariform teeth.*

The direction of the dominant movement of the jaw exerts a marked effect upon the size, curvatures, proportions, and number of enamel plates of the molariform teeth. This is well shown in comparing teeth from skulls of the same size of *Macrogeomys dolichocephalus* and *Platygeomys gymnurus.*

(1) *Effect on the size and curvature of the prisms.*—The length of the molariform series on the crowns is approximately the same in both. In *M. dolichocephalus*, in which the principal movement is antero-posterior or nearly so, the premolars and last molars, which form the end posts of the series, are very much lengthened and enlarged, while the intermediary molars are essentially the same size as in *P. gymnurus*, in which animal the principal movement is transverse or obliquely transverse. The lower premolar of *dolichocephalus* (fig. 42, *a*) contrasted with that of *gymnurus* (fig. 42, *b*) is not only larger and longer, but its root curves forward much more strongly, increasing its resisting power as a brace. Throughout the group this tooth (the lower premolar) acts as an immovable post or buttress against which the molars press during the to and fro grinding movement; hence it is naturally largest in those species in which the principal movement is antero-posterior (see fig. 26).* The intermediary upper molars (m^1 and m^2) are longer and less curved in *dolichocephalus* than in *gymnurus;* the intermediary lower molars (m_1 and m_2) are essentially equal in length in the two forms and are equally curved, but the curvatures are different: In *M. dolichocephalus* the upper half of the prism is nearly straight, particularly in m_2; the curvatures are more abrupt; the anterior curve is much greater than in *gymnurus*, and the spiral twist is more pronounced, the root end of the teeth rotating more strongly inward. The posterior molar, both above and below, is much broader and heavier in *dolichocephalus* than in *gymnurus*, and the upper one is more strongly curved backward. The strong outward inclination of the roots of the end teeth of the series tends to keep the molars perpetually keyed up, preventing any spacing between the crowns. The destructive effects of the to-and-fro movement of the powerful planing machine are thus successfully offset.

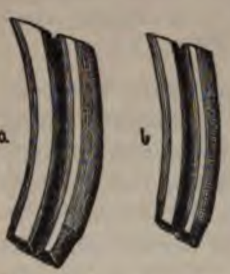

FIG. 42.—Lower premolar showing difference in size and curvature according to whether the dominant jaw movement is to and fro or sideways. *a Macrogeomys dolichocephalus; b Platygeomys gymnurus.*

*What the lower premolar accomplishes by its massiveness and fixed position, the upper premolar accomplishes by its length and angle of implantation.

(2) *Effect on the proportions of the prisms.*—The breadth of the molar prisms with respect to their antero-posterior diameter is materially affected by the direction of the dominant movement of the jaw. This is readily seen in the crowns which are much more elongated transversely in those species in which the principal movement is obliquely transverse (*P. gymnurus* and others) than in those in which it is chiefly antero-posterior (*M. dolichocephalus* and others). In the former series the transverse diameter of the crown (of upper molars) averages two and one-half times the antero-posterior; in the latter, only two times.

(3) *Effect on the number and size of the enamel plates.*—Perhaps the most conspicuous and important of the differences in the molariform teeth, resulting from the direction of the dominant movement of the jaw, is in the number of the enamel plates on the upper intermediary molars. Two plates are invariably present in those forms in which the dominant movement is antero-posterior (genera *Geomys*, *Zygogeomys*, *Orthogeomys*, *Macrogeomys*, and *Heterogeomys*); while only one is present in those in which the movement is obliquely transverse (genera *Platygeomys* and *Cratogeomys*). In the latter case the enamel is restricted to the front face of the tooth, the posterior plate being obsolete, and the upper premolar resembles the molars in this respect, the posterior enamel plate being invariably absent.

ARRANGEMENT AND MODE OF OPERATION OF THE CUTTING BLADES.

The arrangement of the enamel plates and the direction of the dominant movement of the jaw in mastication present two widely different types in the animals under consideration. In one of these types the principal movement is obliquely transverse; in the other it is antero-posterior. They may be best considered separately.

(*a*) *Dominant movement of jaw obliquely transverse.*—When the upper tooth row of *Platygeomys gymnurus*, or any other species in which the dominant movement is obliquely transverse is examined as a whole, it is found to be made up of five flattened columns of dentine arranged seriatim one in front of another, and each faced in front with a vertical plate of enamel which projects a short distance beyond the crown (fig. 43 [1]). These five enamel plates are strongly convex forward and their curvatures are essentially parallel (fig. 44 [1]). An additional enamel plate covers the posterior face of the anterior pillar of the premolar and the isthmus connecting the two parts of this tooth; and the two lateral plates of the last upper molar may be considered as together forming another cutting plate, making seven in all in the upper series. Turning now to the opposing series—the lower molars—the opposite or complementary condition prevails, a curved enamel plate covering

FIG. 43.—Longitudinal section of molariform teeth of *Platygeomys gymnurus* (diagrammatic). (1) Upper; (2) lower.

the posterior face of each of the five flattened columns of dentine (figs. 43[2] and 44[2]). Two additional transverse plates complete the armament of the lower premolar, making seven in all, as in the upper series. It should be observed further that the concave sides of the five regular enamel plates face *backward* in the upper series and *forward* in the lower series. If now the two series are superimposed in the position they naturally assume in the mouth (fig. 45), and the lower series is moved obliquely forward and outward in the direction it normally takes when drawn by the masseter, the two sets of curved enamel blades come together like the opposing blades of seven pairs of shears working almost simultaneously, with this difference in favor of the teeth, that in addition to the antero-posterior closing movement the curved blades slide over one another laterally, thus giving the greatest possible advantage in slicing the hard roots and other unyielding substances on which the animals feed. The length of the blades gives a long sweep, while the curvature* insures the passage of

FIG. 44.—Crowns of molariform teeth of *Platygeomys gymnurus*. (1) Upper series; (2) lower series.

FIG. 45.—Superimposed molar series of *Platygeomys gymnurus* showing relations of enamel blades (light outlines lower series; dark, upper); *a* front end.

each particle of food against the cutting edges. The action is still further favored by the oblique truncation of the molar crowns and the peculiar method of suspension already described whereby the unyielding enamel blades gain an elasticity which gives them a shearing motion of the highest efficiency. The cutting is done during the obliquely forward movement of the mandible; the complementary movement is simply one of recovery and has no effect on the food.

The forward movement is evidently complex and apparently consists of three independent motions by which the mandible is shifted from side to side in a zigzag manner, as follows: (1) The mandible is carried obliquely forward and to one side until each of the enamel blades has completed a shearing cut against one of the blades of the upper series; (2) it is then carried obliquely forward in the opposite direction until each blade completes another cut; (3) it then turns again and the molar blades accomplish a third cut, leaving the upper and lower series

*The concave sides of the enamel blades move toward and over one another, inclosing the food in a rapidly contracting loop, the opposite sides of which meet and pass, leaving no chance for food to escape.

nearly in the same vertical plane. The lower series has been carried forward so that each tooth stands considerably in advance of the corresponding tooth of the upper series. A fourth movement, that of recovery, brings the mandible back to the starting point. The limit of the to-and-fro movement is nearly the same throughout the family *Geomyidæ* and is measured by the antero-posterior diameter of the crown of the premolar, which it slightly exceeds. When the jaws are at rest the front face of the lower premolar rests on or slightly behind the corresponding face of the upper premolar. When the jaw is drawn forward until the lower incisor strikes the posterior beveled face of the upper incisor, the lower premolar stands free from and wholly anterior to the upper. Hence, the thickness of the premolar is slightly less than the distance covered in the to-and-fro movement of the jaw. This being the case, it is easy to ascertain the number of cuts made by the enamel blades during each stroke of the jaw in mastication. By superimposing tracings of the upper and lower molar series (fig. 45) and moving the latter obliquely forward and outward under the former it appears that of the four cutting blades of the lower premolar the first is unimportant, the second glides over two cutting edges of the upper premolar during each stroke, the third and fourth cut against three edges each, and the single blade of each of the three true molars cuts over three enamel plates of the upper series (counting as one the two lateral plates of the last upper molar against which they cut), making seventeen cuts for each stroke of the jaw.

In a tame *Geomys lutescens* it was found (by actually counting the contractions of the temporal muscle) that the mandible makes 200 complete strokes a minute, which, at the rate of 17 cuts with each stroke, is equivalent to 3,400 cuts by a single pair of blades. This is the number of cuts made by the blades of a single ramus; but since the blades of both sides doubtless act simultaneously the number should be doubled, making a total of 6,800 cuts each minute!

The enamel plates are so spaced, by means of slight differences in the antero-posterior diameters of the upper and lower molars, that when the jaws are shut together and the movement of mastication takes place, only one pair of cutting edges comes into bearing at a time. The seven sets of blades, therefore, instead of cutting simultaneously, follow one another in rapid succession, one pair just completing its stroke as the next begins. By means of this delicate adjustment only one-seventh the power is required that would be necessary if all operated together.

If, in the animals having the above described shearing movement of the molars, a posterior enamel plate was present in the upper intermediary molars, or an anterior plate in the lower molars, the possession of such plates would obviously be a mechanical disadvantage, as they would not only be of no use but would be actually in the way. Hence, in the evolution of this specialized type one plate has been suppressed;

and the fact should be emphasized that the loss of a useless enamel plate is as clearly a sign of specialization as the development of an additional plate where needed. In the less specialized genus *Thomomys* both plates are always present (fig. 32, *b*).

(*b*) *Dominant movement of jaw antero-posterior.*—In the remaining groups the movement of the jaw is chiefly antero-posterior, the crowns of the teeth are more broadly elliptical, and enamel plates are present on both sides of the upper molars (figs. 46 and 47). In some genera the posterior plate, which is always thinner than the anterior, covers the whole hinder face of the tooth; in others it is restricted to the inner side, according to the exact axis of jaw movement. Whenever the ellipse is broad, and is so directed with reference to the enamel plates of the adjacent teeth that it presents a free edge *toward* the food that is being ground, this edge is invariably protected by a plate and cutting edge of enamel. Conspicuous illustrations of this law may be seen in the upper premolar of *Zygogeomys*, *Macrogeomys*, and *Heterogeomys*, and in the upper intermediary molars of *Zygogeomys*, in all of which the posterior enamel plate is restricted to the *lingual* side—the side impinged upon by the food. On the other hand, non-cutting edges protected by the enamel plates of adjacent teeth are better off without enamel of their own, because such enamel, if present, would not only be of no use, but would be actually in the way, as already explained.

FIG. 46.—Longitudinal section of molariform teeth of *Macrogeomys dolichocephalus* (diagrammatic). (1) Upper series; (2) lower.

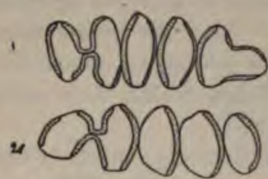

FIG. 47.—Crowns of molariform teeth of *Macrogeomys dolichocephalus*. (1) Upper; (2) lower.

By superimposing tracings of the upper and lower molar series of *Macrogeomys dolichocephalus* (fig. 48) and moving the lower backward and forward under the upper as nearly as possible in the way they are moved by the living animal, it is found that the cutting blades make nineteen cuts during each forward stroke of the jaw, as follows: The

FIG. 48.—Superimposed molar series of *Macrogeomys dolichocephalus* showing relations of enamel blades. Light outlines, lower series; dark, upper. *a* front end.

anterior plate of the lower premolar does not cut at all, or, if it cuts its action is so limited as to be of no particular consequence; the posterior plate of the anterior prism makes two cuts; the anterior plate of the posterior prism, three cuts; the posterior plate of the premolar and that of the first molar make four cuts each; the second and third molars, three cuts each (counting the two lateral plates of the upper molar, against which m_1 acts, as if they were a single plate), making nineteen in all. During the return movement fourteen cuts are made, as follows: The second and third transverse plates of the premolar make two cuts each; the fourth, three; the first molar, three; the second and third molars, two each. The backward stroke is evidently less powerful and less effective than the forward stroke.

Since the teeth on both sides of the mandible cut simultaneously, the total number of cuts during each complete stroke will be double the number above mentioned, or 38 for the forward stroke and 28 for the backward stroke. Assuming that the number of complete strokes each minute is the same as in *Geomys lutescens*, namely, 200, the total number of cuts made each minute on the forward stroke would be 7,600, and on the backward stroke 5,600, making a grand total of 13,200 cuts each minute while the jaws are in active operation!

Stroke of the jaw.—There being no postglenoid process, the backward movement of the jaw is not interrupted until the condyle strikes the auditory bulla at the base of the tube of the meatus. When the condyle rests in this position and the molar series are in apposition, the front faces of the premolars above and below are in line. The forward movement of the jaw is stopped by the incisors and reaches its limit when the front face of the lower incisor strikes against the posterior face of the beveled edge of the upper incisor. When this happens the upper premolar usually rests on the back part of the first lower molar.

From the foregoing account it must be clear that the molars, which, considered as individual teeth, are simple elliptical tubes, lacking the complicated enamel patterns of the beaver, porcupine, and many other rodents, are so constructed that collectively they form one of the most powerful and highly specialized cutting and slicing machines known. The way the narrowly elliptical crowns are placed side by side flatwise, the hard projecting enamel blades alternating with surfaces of soft dentine, results in the production of a cutting and rasping apparatus equal if not superior to that possessed by those rodents and ungulates that have complicated enamel folds within the substance of the teeth. The obliquity of the crowns, whereby the upper and lower series are brought together in the arc of a circle, gives them remarkable power under the transverse movement of the jaws, while the way the teeth are suspended on vertical cushions, together with the angle of implantation and the double curvatures of their prisms, enables them to withstand the great strain to which they are subjected without danger of displacement and without injury to the tender pulps at their bases.

The secondary modifications of the skull resulting from the action of the muscles operating this wonderfully effective machinery are discussed elsewhere (pp. 104–107).

TREATMENT AND COURSE OF THE FOOD.

The circumstance that all the members of the *Geomyidæ* live underground has an important bearing on the kind of food habitually eaten, and is thus the remote cause of the special adaptations of the dental armature, and of the secondary cranial modifications necessitated thereby. The animals sometimes come to the surface and cut the stems and leaves of plants, which they draw into their subterranean tunnels, but in the main the choice of food is restricted to such parts of plants as may be found within the ground. The food therefore consists chiefly of tubers and roots, including the hard roots of trees and shrubs, the tough rootstalks of the mescal or agave, and the like. In dealing with these unyielding substances the animal gains one decided advantage—the roots on which it feeds are held firmly in place by the earth while pieces are chiseled off by the broad, trenchant cutting edges of the powerful incisors. In the case of certain relatively soft substances, such as potatoes, the lower incisors are sometimes used alone, both as a pry to dislodge pieces and as a scraper to scrape off thin slices, but as a rule both upper and lower incisors operate together. The principal function of the upper incisors seems to be to transfix the tuber and oppose the action of the lower while the latter do most of the work, moving rapidly backward and forward (and at the same time upward), until a piece of food is cut loose or sufficiently undermined so that it may be torn loose by a backward movement of the head while the teeth are held firmly together. The bit of food thus dislodged is either reduced in size by trimming—during which operation it is held between the large forefeet, the long claws turned inward toward one another—or is passed directly into the mouth or cheek pouches. The mouth proper, it should be remembered, is separated from the incisors by a furry partition which is directly in front of the molars. This diaphragm-like partition is of great service to the animal, keeping dirt and chips out of the mouth. When the food reaches the mouth proper the tongue and lips keep it between the teeth, where it undergoes the treatment commonly described as grinding. But in the highly specialized forms of the *Geomyidæ* no real grinding occurs—the whole process is one of cutting or slicing. The arrangement of the enamel plates that form the blades of the cutting machine has been already described in detail. In those species in which the principal movement of the jaw is antero-posterior the mechanism is essentially a *planing* machine, while in those in which the dominant movement is obliquely transverse it is a *shearing* or *slicing* machine. In either case the tough vegetable fibers composing the food are quickly reduced to a pulp, which is promptly passed on to the stomach for digestion.

MUSCLES THAT OPERATE THE CUTTING MACHINE.

The principal muscles concerned in the movements of the jaw are (1) temporal, (2) masseter, (3) internal pterygoid, (4) external pterygoid,

(5) digastric, and (6) transverse mandibular. Of these, by far the most important single muscle is the masseter.

The *temporal* muscle occupies the whole of the upper surface of the cranium behind the orbits, covering the parietal, squamosal, and posterior part of the frontal as far forward as the postorbital prominence. It arises from the flat upper surfaces of these bones and from the lambdoid and sagittal crests. The muscle is indistinctly divided into two parts—a superficial and a deep—which are not well defined in their origin. The fibers of the muscle as a whole converge anteriorly; those of the superficial part are inserted into the apex, posterior edge, and inner side of the coronoid process; those of the deep part play over the trochlear groove and at the margin of the orbit drop vertically downward and are inserted by a dense aponeurosis on the anterior edge of the basal half of the coronoid ramus from the plane of the molar crowns upward to a point slightly above the plane of the coronoid notch; posteriorly the muscle remains fleshy and covers the inner side of the coronoid ramus where its insertion extends downward to the bottom of the deep pit between the ramus and the posterior molar. The function of the temporal muscle is to shut the mouth, and in some species to draw the mandible slightly backward. Operating in connection with the digastric, it performs the backward stroke of the to-and fro movement of the jaw in the *dolichocephalic* series, the masseter producing the forward stroke.

The *masseter* is a large complex muscle and is by far the most important of the muscles concerned in the act of mastication. It is incompletely divided into three parts, which, from their principal sources of origin, may be described as the rostral or superficial, maxillary, and zygomatic parts.

(1) The *rostral* or superficial part arises by a long and dense aponeurosis from the outer side of the rostrum on the line of the premaxillo-maxillary suture, its upper border being immediately in front of the infraorbital foramen. It passes thence obliquely downward and backward, developing muscular fibers and spreading out posteriorly into a flat muscular band which is inserted upon the inferior crest of the masseteric fossa and the inferior surface of the mandible from the digastric crest posteriorly to the base of the angular process, its insertion being wholly fleshy. It is the most powerful muscle in drawing the jaw straight forward, and is aided in the *dolichocephalic* species by the zygomatic branch of the masseter.

(2) The *main body of the masseter* arises from the side of the anterior part of the maxilla and adjacent parts of the maxillary root of the zygoma. Anteriorly it slightly overlaps the posterior part of the premaxilla immediately below the top of the rostrum, where it forms a distinct crest continuous with the anterior edge of the maxillary root of the zygoma. The principal origin covers the whole of the anterior face of the vertically expanded zygomatic process of the maxilla, and

in addition a thin supplementary sheet takes origin from the posterior face of the same bony plate (within the orbital chamber). Posteriorly its origin is limited on the outer side by a thick aponeurosis, which is firmly attached to the inferior surface of the antero-external angle of the zygoma. The part within the orbit follows the inner face of the horizontal part of the zygoma all the way back to the glenoid ligament, to which its posterior fibers are attached. This part of the muscle is inserted on the outer side of the neck of the condylar ramus just above the incisor capsule.

(3) The *zygomatic part* of the masseter arises from the outer side of the horizontal part of the zygoma, its origin embracing the outer surface of the squamosal root of the zygoma and the outer side of the jugal below the oblique crest which marks the limits of its insertion above and in front. It arises also from the aponeurotic septum which separates it from the main body of the muscle. It is inserted upon the angular process of the mandible, its insertion covering the upper surface of this process from the incisor capsule outwardly to and over the head of the process, and also the under surface of the process to its very base, where its insertion becomes continuous with that of the main body of the muscle. Its function in *Geomys* proper and in all the *dolichocephalic* species is to draw the jaw forward. In the *platycephalic* species its insertion is carried so far outward by the great elongation of the angular process that it serves to move the jaw sideways, in which act it is aided by the pterygoid muscles.

The *internal pterygoid muscle* arises from the pterygoid fossa of the skull, which it completely fills. Passing directly outward and slightly downward, it is inserted into the pterygoid fossa of the jaw, where its line of attachment has developed a strong crest along the posterior edge of the angular process. Its function in *Geomys* proper and in all of the *dolichocephalic* species seems to be to bring the posterior end of the molar series firmly together when the jaw is shut. In the *platycephalic* species it aids the masseter in moving the jaw sideways.

The *external pterygoid* arises from the alisphenoid bone on the outer side of the root of the last upper molar and is inserted into the inner side of the neck of the condyle. Its function is evidently mainly the same as that of the internal pterygoid, though in addition it tends to move the mandible slightly forward.

The *digastric* arises from the paroccipital process and adjacent parts of the mastoid and audital bullæ, and is inserted on the digastric crest, which projects backward from the hinder part of the symphysis of the mandible. It is largely developed, its function being not merely to open the mouth, but, operating with the temporal, to draw the jaw strongly backward in the to and fro movement of mastication in the *dolichocephalic* series. Its action is very direct and powerful.

The *transverse mandibular muscle* connects the two halves of the lower jaw immediately behind the symphysis, where, in many species, there is a distinct fossa for its lodgment. It must fulfill an important function in regulating the adjustment of the tooth rows during mastication.

MUSCLES OF THE CHEEK POUCHES.

I have not dissected the muscles of the cheek pouches, but they have been described by Dr. C. E. McChesney* and Prof. H. L. Osborn.† Dr. McChesney states that the aperture of the pouch is surrounded by a narrow delicate constrictor muscle, and that the long pouch itself, which extends back to the shoulder, is enveloped by a contractor muscle which seems to be a modified part of the *platysma myoides*. This muscle consists of two parts: (1) a retractor part, reaching from the extreme posterior end of the pouch backward over the muscles of the back and ending in a broad thin tendon which blends with the tendons of the superficial dorsal muscles, to be inserted into the spines of the three last lumbar vertebræ; (2) an anterior part which envelops the pouch proper. This latter is in turn subdivided into two parts—external and internal. The former covers the upper or outer portion of the pouch and is inserted into the maxillary bone (probably *pre*maxillary). The latter covers the inner and under sides of the pouch and is attached to the mandible, though the uppermost fibers join those of the former division, to be inserted on the upper jaw. Dr. McChesney states that the lower and inner surface of the muscle is thickest, the outer surface being thin and of little power.

Prof. Osborn describes the muscles of the pouch as follows: "There are three distinct sets of muscles; these are, first, a circular muscle that runs around the margin of the pocket in its outer bounding fold. This by its contraction would seem to purse the opening of the pocket. The second set of muscles are those that I will call the protractors of the pockets. These are two in number on each side. They are spread out in the skin of both the inner and outer posterior portions of the pockets, and their fibers converge forward to finally form somewhat definite bands. The outer of these is attached in the skin at the origin of the fold on the upper jaw. The other is attached to the lower attachment of the fold at the lower jaw. These two muscles thus surround the pocket, and their contraction pulls its recess forward to the opening of the vestibule. The third set of muscles are the retractors of the pocket. These arise funnel-wise from surface of the pocket, both on its inner and outer aspects, and they run backward and dorsally parallel to the fibers of the latissimus dorsi and totally free from the skin. They form a band three or four inches long and nearly an inch wide, and are finally inserted in the tendinous aponeurosis that covers the insertion of the latissimus dorsi and is attached to the neural spines of the anterior lumbar vertebræ. These by their action retract the pockets."

* Bull. U. S. Geol. and Geog. Survey Terr., IV, No. 1, Feb., 1878, 214-215.
† Science, XXIII, Feb. 23, 1894, 102-103.

PRINCIPAL MUSCLES CONNECTING THE HEAD WITH THE NECK.

The *sterno-mastoid* muscle arises by a tendinous aponeurosis from the manubrium of the sternum and is inserted into the mastoid process of the squamosal immediately behind the auditory meatus.

The *cleido-mastoid* arises from the middle part of the clavicle and is inserted on the upper or dorsal aspect of the mastoid process of the squamosal immediately over or above the insertion of the sterno-mastoid. Its fibers are but little separated from those of the trapezius.

The *trapezius* muscle arises from the ventral surface of the outer third of the clavicle and the adjacent acromial process of the scapula and the spine of the scapula for its entire length; near the median line its fibers seem to be continuous with those of the median part of the *latissimus dorsi*. It is inserted on the lambdoid crest for its entire length, its outer edges being continuous with the insertion of the *cleido-mastoid*.

The *rhomboideus* lies immediately below the trapezius. It is much less extensive than the latter, but considerably thicker. It arises from the superior face of the spine of the scapula and the adjacent anterior part of the vertebral border of the scapula, and is inserted into the posterior face of the lambdoid crest immediately beneath the insertion of the trapezius.

ANALYSIS OF JAW MOVEMENTS.

Turning now from the consideration of the individual muscles to the study of the origin of the complex movements of the jaw in chiseling and slicing the food, even greater difficulties are encountered. The following attempt, therefore, is subject to correction.

(1) *The act of chiseling.*—From what has been said it appears that the act of chiseling is performed in essentially the same way in both the *platycephalic* and *dolichocephalic* members of the group, and that it is due to the joint action of the masseter and temporal muscles, the former being more effective than the latter.

The thin enamel edge of the upper incisors is used chiefly as an anchor to fasten the cutting machine firmly to the object operated upon, while the lower jaw plays back and forth like a drill in accomplishing the work. The exserted part of the upper incisors, therefore, is curved downward and inward, and the edge, which is very thin and sharp, is broken by one or more grooves, which enable it to penetrate hard substances more easily than if it were straight. The face of the lower incisor slopes strongly forward as well as upward and the axis of its movement in cutting must be obliquely forward and upward. The principal muscle concerned in chiseling is the *masseter*, which is aided by the *temporal*, and in some cases also probably by the *pterygoids*. The way the posterior part of the ramus of the mandible curves upward in the arc of a circle has a highly important bearing on the efficacy of the action of the masseter, and has doubtless been molded into its present shape by this all-important muscle. The rostral part of the masseter is nearly horizontal; from its aponeurotic origin on the sides of the rostrum it spreads out posteriorly and is inserted broadly over the posterior curvature of the upturned ramus of the mandible, its action being to draw the mandible as a whole directly forward. The main body of the muscle is nearly vertical, but slopes slightly backward from its maxillary origin to its insertion on the outer side of the mandible; in contracting draws the jaw slightly forward and powerfully upward. In those species in which the zygomatic part of the masseter is nearly vertical instead of transverse this part of the muscle aids the rest in moving the jaw forward and upward. The masseter is aided still further by the temporal muscle, which, using the condyle as a fulcrum, moves the lower incisors upward.

(2) *The act of slicing.*—The act of slicing the food is performed in different ways in the two series of animals, being chiefly a to-and-fro movement in the *dolichocephalic* species and a transversely oblique rotary movement in the *platycephalic* species. In the *dolichocephalic* species both the forward and backward movements are important, while in the *platycephalic* species the backward movement is merely one of recovery.

In the *dolichocephalic* series, therefore, the forward movement produced by the masseter requires a powerful counter movement in bringing the jaw back. This is supplied, apparently, by the joint action of the digastric and the deep part of the temporal. The latter holds the teeth firmly together and draws the jaw slightly backward, while the digastric, contracting at the same time, pulls the jaw powerfully backward, the superficial part of the temporal, which is inserted on the coronoid process, preventing it from opening the mouth.

In the *platycephalic* series, as already stated, the principal movement is obliquely transverse, the jaw being drawn outward and forward. The muscles producing this action are the zygomatic part of the masseter and the pterygoids. It is probable that they are largely aided by the deep portion of the temporal, which is inserted into the pit on the outer side of the posterior molars. The fibers of this part of the temporal muscle being vertical, bring the teeth firmly together and draw the under jaw slightly outward, which movement, in connection with the angle of truncation of the crowns of the teeth, must result in the transverse rotary motion.

The mouth is opened by means of the digastric muscle, which is beautifully adapted to this end, its origin taking hold of the posterior part of the cranium on each side of occipital condyles, while its insertion is carried forward all the way to the symphysis of the jaw. The digastric does not appear to be assisted by any other muscle in performing its function of opening the mouth.

INFLUENCE OF THE MASSETER MUSCLE IN MOLDING THE SKULL AND MODIFYING THE TEETH.*

Throughout the *Geomyidæ* the masseter muscle has profoundly modified the form of the skull and the character of the teeth, and is largely responsible for the extraordinary cranial peculiarities that distinguish the several genera. Perhaps it would be better to say that slight differences in the direction of the principal movement of the jaw in grinding the food, which have proved an advantage to the animal, have by natural selection developed certain fibers or parts of the muscle at the expense of other parts, and that the differences thus originated have been perpetuated and intensified until the muscle has in turn molded the bones to which it is attached, and also those with which it comes in contact, thus altering the form and proportions of the cranium as a whole, and giving rise to extreme variations in the size, shape, and position of the zygomatic arch and in the development of the angle of the jaw. At least two very distinct types of skull have been established in this way—a broad or *platycephalic* type (pl. 3) and a narrow or *dolichocephalic* type (pl. 5).†

By contrasting the accompanying figures of representative skulls of these two types, with respect to the areas of attachment of the princi-

FIG. 49.—Side view of skull of *Macrogeomys dolichocephalus*, showing relations of mandible, and fossæ for attachment of muscles.

a Angle of mandible.
ic Incisor capsule.
jo Jugal origin of masseter.
m Mastoid process of mastoid bulla.
ms Mastoid process of squamosal.
mf Masseteric fossa.
mo Maxillary origin of main body of masseter.
mss Mandibular shelf (leading to angle in *Platygeomys gymnurus*).

pal parts of the masseter, the action of the muscle and its effects on the skull may be better understood. Without repeating the detailed

*For an important chapter on the general subject of the influence of the muscles in shaping the skull in the Rodentia, see Herluf Winge, Jordfundne og nulev. Gnavere fra Lagoa Santa, Minas Geraes, Brasilien, 1888, 103–110.

† These extremes in the form of the skull are brought about mainly by alterations in the superficial or outer parts, the fundamental structures and relations remaining very much the same in both, as shown by sectionized skulls (pls. 17 and 18).

descriptions already given under the head of the muscle (p. 99), it may be stated that the principal part of the masseter arises from the side of the maxilla in front of the zygomatic arch, and from the adjacent parts of the premaxilla and the maxillary root of the zygoma (fig. 49, *mo*). It is inserted upon the outer side of the mandible, and the area covered by its insertion—the *masseteric fossa*—extends from the angle to the plane of the front of the premolar (fig. 49, *mf*). Its origin, insertion, and relations are essentially the same throughout the group. The jugal part arises from the horizontal arm of the zygoma and is inserted upon the upper side and end of the angle of the jaw. Its size, form, area of origin, axis, and relative importance differ conspicuously in the various members of the series. In some forms it arises from the entire length of the horizontal part of the arch (fig. 50, *jo*); in others from the posterior part only (fig. 49, *jo*). The upper limit of its origin is marked by an oblique line and a change of direction in the outer face of the jugal.*

Effect on the skull.—In the long and narrow skulls, of which *Macrogeomys dolichocephalus* may be taken as a type, the great body of the

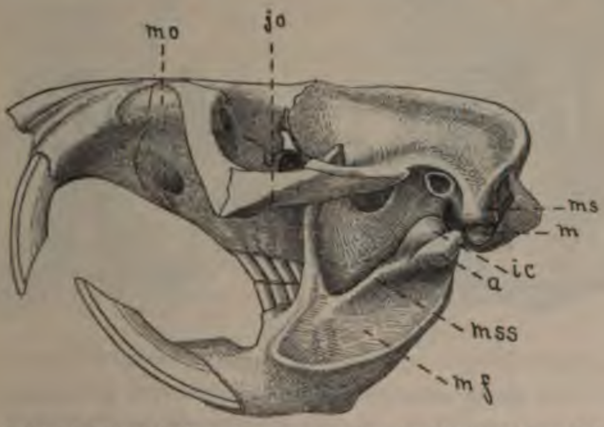

FIG. 50.—Side view of skull of *Platygeomys gymnurus* showing relations of mandible and fossæ for attachment of muscles. Lettering same as in fig. 49.

masseter is parallel to the side of the face, its function being to close the jaws firmly and draw the mandible forward. Its principal origin is maxillary, the jugal part being small and posterior to the plane of the middle of the orbit (fig. 49, *jo*). The resulting principal movement of the jaw is antero-posterior. The action of the muscle has narrowed the zygomatic arches, rounded off their anterior angles, and lifted them out of the way until the horizontal part of the arch is much nearer the

* Owing to the scarcity of material for dissection the masseter muscle itself has been actually examined in two forms only, namely, *Geomys bursarius* and *Macrogeomys dolichocephalus*. Its relations in these species, studied in connection with the well defined fossæ on the skull marking its origin and insertion, furnish a very good guide to its modifications and to the part it has played in producing the several types of cranium known in the group.

top of the skull in front than behind (fig. 49). The fibers of the jugal branch are nearly vertical, and are of little use except in drawing up the back part of the jaw. This may be seen from fig. 52: the muscle passes downward from the zygoma (*zy*) to the angle of the jaw (*a*).

In the broad and flat skulls, of which *Platygeomys gymnurus* may be taken as a type (fig. 50), the jugal branch of the masseter is largely developed, its function being to move the jaw sideways at the same time that the maxillary part brings the teeth firmly together. The resulting principal movement of the jaw is obliquely transverse. In producing this lateral movement the jugal branch is aided by the pterygoid muscles, but the latter must have played a very subordinate part in molding the skull. The jugal part of the masseter in the *platycephalic* series is not only of relatively large size, but the area of its origin is greatly extended (fig. 50, *jo*) and the axis of its fibers has become more nearly horizontal than vertical (fig. 54, *a* to *zy*). Its origin occupies the outer and inferior surface (and probably most of the inner surface also) of the horizontal part of the zygomatic arch for

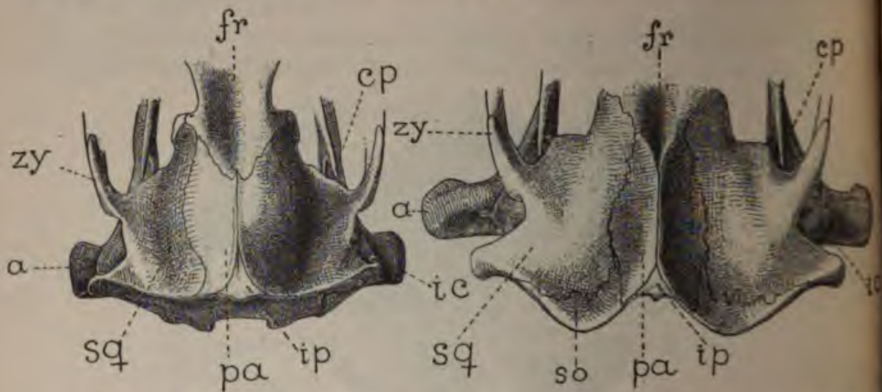

FIG. 51.—*Macrogeomys dolichocephalus*. FIG. 53.—*Platygeomys gymnurus*.

Posterior part of cranium from above, showing relations of mandible in place.

a Angular process of mandible.
cp Coronoid process of mandible.
ic Incisor capsule (covering root of lower incisor).
ip Interparietal.
fr Frontal.
pa Parietal.
so Supraoccipital.
sq Squamosal.
zy Zygoma.

its entire length, its anterior end being in front of the plane of the orbit. The action of this part of the masseter has drawn the zygomatic arch far outward and has pulled the anterior angle downward until the latter is further from the plane of the top of the skull than the posterior end of the arch. The angle is thus drawn down until it reaches four-fifths of the way from the plane of the top of the skull to the plane of the molar alveolus, overreaching and overarching the maxillary or principal part of the masseter muscle, which operates beneath it (fig. 50, which should be contrasted with fig. 49 of *Macrogeomys dolichocephalus*). The insertion of the muscle has produced an equally extraordinary effect upon the shape of the under jaw. The sides of the jaw are not only spread widely apart in conformity with the great breadth of the skull, but in addition the fibers of the masseter that are inserted on the angular process have stimulated this process to push out sideways until it reaches off like a long arm at nearly a right angle to the axis of the skull (figs. 53 and 54, *a*).* The lengthening of this process was clearly necessitated in order to continue the effective action of the muscle. Furthermore, the segregation and specialization of the

FIG. 52.—*Macrogeomys dolichocephalus.* FIG 54.—*Platygeomys gymnurus.*

Transverse vertical section of skull, with mandible in position, showing relations.

a Angular process of mandible.
alc Alisphenoid canal.
alh Horizontal arm of alisphenoid.
c Condyle of mandible.
cp Coronoid process of mandible.
f Angle of crowns of closed molars.
ic Incisor capsule (covering root of lower incisor).
np Narial passage.
pa Parietal.
pf Pterygoid fossa.
sq Squamosal.
zy Zygoma.

two parts of the masseter in the *platycephalic* series has resulted in the production of a long and well-defined horizontal shelf extending forward from the angle of the jaw to the base of the ascending ramus (fig. 50 *mss*). This shelf is totally wanting in *Macrogeomys dolichocephalus* and the other *dolichocephalic* forms in which the jugal part of the masseter is relatively unimportant and the principal movement of the jaw is fore and aft instead of transverse. The relations described may be seen to good advantage in the accompanying drawings (figs. 49–54).

Effect on the teeth.—While from the nature of the case it is clearly impossible to observe exactly what happens, either in the muscles or the teeth, during the act of mastication, it is at the same time permissible to draw certain inferences from the mechanical construction of the apparatus. In the case of the teeth, considered as the focus of the cutting machine, it has been already shown that two types exist, one

* In *M. dolichocephalus* the angle projects only 2½ mm. beyond the plane of the zygoma (fig. 52), while in *P gymnurus* it projects 10½ mm.

in which the crowns of the upper intermediary molars are broadly elliptical and bear two enamel plates (one on each face); the other in which the crowns are narrowly elliptical and bear only one enamel plate (which is on the anterior face). It has been shown further that the presence of two enamel plates is always correlated with an antero-posterior movement of the jaw, and that the presence of a single plate is always correlated with an obliquely transverse movement of the jaw. A careful study of the cutting blades in each instance shows that an antero-posterior movement is accompanied by a to-and-fro planing action in which two enamel blades are serviceable; and that a transversely oblique movement is accompanied by a lateral shearing action in which only a single blade can be used. In accordance with the well-known law that useful structures are preserved and useless structures suppressed, it is logical to infer that the direction of the dominant movement of the jaw has determined the presence or absence of the posterior enamel plate; and since the movement of the jaw is controlled by the masseter muscle, it is evident that the number of enamel plates on the upper intermediary molars may be traced back to the influence of this muscle.

In the course of the evolution of the two types just described it seems evident that as soon as the principal movement of the jaws in the line leading to *Macrogeomys dolichocephalus* came to be fore and aft it was settled that the form of the posterior part of the cranium should be narrow; that the angle of the under jaw should be shortly truncate; that the grinding teeth should be broadly elliptical, and that the posterior enamel plate of the upper series should be retained; and when the principal motion of the jaw in the ancestors of *Platygeomys gymnurus* came to be obliquely transverse, from that moment it was predetermined that the hinder part of the skull should be broadly expanded; that a long arm-like process should spring from the angle of the jaw; that the grinding teeth should be transversely flattened, and that the posterior enamel plate of the upper series should disappear.

CHAPTER IV.

SYSTEMATIC DESCRIPTIONS OF GENERA AND SPECIES.

Genus GEOMYS Rafinesque, 1817.

(Pls. 1, 7, 9, 12; pl. 15, figs. 11 and 12; pl. 17, fig. 3; pl. 18, fig. 1; pl. 19, fig. 3, and text fig. 55; maps 1 and 4.)

Type *Mus tuza* Ord, 1815, from AUGUSTA, GEORGIA. (=*Geomys pinetis* Raf., 1817).

Geomys Rafinesque, Am. Monthly Magazine, II, No. I, Nov., 1817, 45. Type *G. pinetis* Raf. (=*Mus tuza* Ord, 1815), from pine barrens near Augusta, Ga.
Diplostoma Rafinesque, Ibid, 1817, 44–45.
Saccophorus Kuhl, Beiträge zur Zool., 1820, 65–66.
Pseudostoma Say, Long's Expd. to Rocky Mts., I, 1823, 406.
Ascomys Lichtenstein, Abh. Akad. Wiss. Berlin (1822), 1825, 20, fig. 2.

Dental characters.—Upper premolar with three enamel plates (the posterior absent). Upper pm decidedly longer than lower (in the other genera they are subequal); shaft of upper pm decidedly concave forward, except in a single species (*G. lutescens*). First and second upper molars with two enamel plates each, the posterior complete; posterior curvature of m^1 and anterior curvature of m_2 hardly apparent.

Last upper molar a single subcylindric or subtriangular prism without lateral sulcus on either side (and consequently without heel); outer enamel plate normally straight; inner and outer plates commonly subequal, or outer somewhat shorter, both reaching posterior face of tooth. Upper incisor strongly *bisulcate* (fig. 22^2 and 22^3; pl. 15, figs. 11 and 12).

Cranial characters.—Skull simple, without any very striking external characters. Orbitosphenoids small and narrow, not reaching alisphenoids (pl. 17, fig. 3); sphenoid fossæ correspondingly elongated, reaching forward to orbital plates of frontal; alisphenoids short posteriorly, ending on floor of brain case about on plane of front ends of audital bullæ; pterygoids large, always forming more than half of the palatopterygoid extensions; mesethmoid plate large, somewhat rectangular, much longer than high, and wholly superior to vomer (not dipping down between vomerine wings as in *Pappogeomys*); endoturbinals collectively forming a quadrate plate, the anterior border of which is parallel to the cribriform plate (pl. 19, fig. 3); first endoturbinal rounded and only slightly expanded anteriorly, its inferior border falling (as the os planum) in the front of the others and articulating with the anterior third of the internal vertical plate of the maxilla—the os planum thus extending anteriorly in front of the lower endoturbinal much further than the length of the latter.

In the elongated skulls of *Geomys bursarius* and *tuza* the lower part of the sphenoidal fissure, on the floor of the orbit, differs from its condition in any of the other groups (fig. 55). In all of the others a fenes-

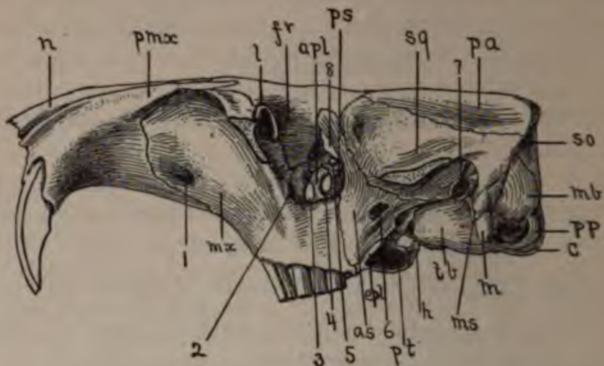

FIG. 55.—Side view of skull of *Geomys bursarius* from outside, zygomatic arch sawed off to show bottom of orbit. Animal a fully adult ♂, from Knoxville, Iowa. (This figure should be compared with the corresponding view of *Cratogeomys merriami*, fig. 4.)

1. Infraorbital foramen.
2. Posterior (orbital) opening of infraorbital canal.
3. Vacuity in front of presphenoid and ascending wing of palatine.
4. Vacuity in presphenoid, behind ascending wing of palatine.
5. Optic foramen (in orbitosphenoid bone).
6. Foramen rotundum and foramen ovale (which have here coalesced).
7. External auditory meatus.
8. Sphenoidal fissure (upper part).

apl. Ascending wing of vertical plate of palatine.
as. Alisphenoid.
c. Condyle of exoccipital.
epl. External pterygoid plate of palatine bone.
fr. Frontal.
h. Hamular process of pterygoid bone.
l. Lachrymal.
m. Mastoid process of mastoid bulla.
mb. Mastoid bulla.
ms. Mastoid process of squamosal.
mx. Maxilla.
n. Nasal.
pa. Parietal.
pmx. Premaxilla.
pp. Paroccipital process of exoccipital.
ps. Presphenoid.
pt. Pterygoid.
so. Supraoccipital.
sq. Squamosal.
tb. Tympanic or audital bulla.

trum (fig. 4,[6])* penetrates the interorbital septum, which at this point consists of the presphenoid only. In *Geomys bursarius* and *tuza* the basal part of the sphenoidal fissure is unusually broad, and the septum at

* In some cases, particularly in *Orthogeomys* and *Zygogeomys*, this fenestrum is subdivided into two or even three parts, but they all invariably penetrate the presphenoid; they are never in front of it.

ts bottom, which here consists of both palatine and presphenoid, is perforated by two fenestra, which look completely through the skull from orbit to orbit. The posterior is the usual opening in the anterior part of the presphenoid (fig. 55,[4]); the other is in front of the presphenoid and is bounded anteriorly by a process from the maxilla, which here rises to join the frontal (fig. 55,[3]). Hence in *Geomys bursarius* there are three openings in the bottom of the orbital fossa, arranged seriatim, one in front of the other. The first is the posterior outlet of the infraorbital canal (fig. 55,[2]); the second is the vacuity here mentioned, which penetrates the skull in front of the presphenoid (fig. 55,[3]); the third is the usual fenestrum in the anterior part of the presphenoid (fig. 55,[4]). The opening in front of the presphenoid is completely surrounded by the maxilla and ascending wing of the palatine—the former bounding it in front, the latter behind—for the ascending wing of the vertical plate of the palatine (fig. 55, *apl*) here rises along the front of the presphenoid between the two fenestra in question and articulates with the maxilla, the orbital plate of the frontal, and the orbitosphenoid. (See also fig. 10.)

The condition here described has not been observed except in the elongate skulls of *Geomys bursarius*, *tuza*, and *personatus*, and is imperfectly developed in the latter. It reaches its highest development in *Geomys bursarius*, and does not occur in the closely related *G. lutescens*, which has a short skull. A condition simulating it sometimes exists in *Orthogeomys*, in which there are several (usually two or three) small perforations in the anterior part of the presphenoid, but the relations of the ascending wing of the palatine are not the same. Very young specimens of *Cratogeomys* resemble the adult of *Geomys* in the presence of a fenestrum in front of the presphenoid and ascending wing of the palatine, but the fenestrum disappears as the animal matures, a vestige of it remaining as a foramen (on each side), which opens from the floor of the orbit obliquely forward and downward into the narial passage.

The genus *Geomys*, even as here restricted, comprises three series or groups of species: (1) the *texensis-breviceps* series, (2) the *tuza* series, and (3) *Geomys busarius*.

(1) The *texensis-breviceps* series inhabits Texas, Louisiana, Arkansas, and the Great Plains, and includes eight species and subspecies, as follows: *arenarius*, *texensis*, *lutescens*, *breviceps*, *breviceps sagittalis*, *breviceps attwateri*, *personatus*, and *personatus fallax*. Most of these, particularly *arenarius*, *texensis*, and *breviceps*, are small generalized forms suggesting relationship with *Thomomys* and *Pappogeomys*. Indeed, these animals are very much alike in many ways and the skulls agree in general form, lightness, in the small rounded brain case, slender and nearly parallel zygomata, narrow pterygoids, and many other characters, though differing conspicuously in the teeth. It seems evident that they are but little removed from the trunk line of the group, and that both the *tuza* and the *bursarius* series are offshoots from the *brevi-*

ceps stem. *Geomys breviceps* seems to be the central or parent type from which three widely different species originated, *tuza* on the east, *bursarius* on the north, and *lutescens* on the west. To the eastward only a narrow gap separates the range of *breviceps* from that of *mobilensis* of the *tuza* series, which, though specifically distinct, was evidently derived from the *breviceps* stock. Still further east *mobilensis* passes in to *tuza*. On the west *breviceps* shades toward and probably will be found to intergrade with *lutescens*. On the north only a narrow hiatus separates it from *bursarius*, the most specialized type of the series. Specimens of *bursarius* from southern Missouri suggest that the gap between it and *breviceps* is not very wide; if continuity of range between the two forms is anywhere found this gap may be bridged even at the present time (see map 4).

(2) The *tuza* series inhabits the South Atlantic and Gulf States south of the Savannah River and east of the Mississippi (mah 4, A), and comprises three forms, *tuza*, *tuza mobilensis*, and *tuza floridanus*. They are locally known by the singularly inappropriate and misleading name 'Salamander.' The members of the *tuza* series agree among themselves and differ from the remaining forms of the genus *Geomys* in having longer and more naked tails, and in numerous cranial characters. The shape of the skull in pofile is decidly convex, the rostrum long and decurved, the nasals long and slender and constricted in the middle, giving them a somewhat hour-glass shape. The interparietal is permanently distinct from the supra-occipital and is normally much larger than in any of the other groups, though in *G. mobilensis* it is nearly obliterated in old age by the encroachment of the ridges that unite to form a sagittal crest.

The *tuza* group differs not only from *bursarius*, but from all other known members of the family, in the disproportionate length of the upper premolar in relation to the other molariform teeth. It is merely double the length of m^1. The lower premolar is much shorter, particularly in *floridanus*.

(3) *Geomys bursarius* inhabits the upper Mississippi Valley (map 4, B) and stands alone at the end of the northern branch, just as *Geomys tuza* occupies the end of the eastern branch of the restricted genus *Geomys*. The skull is elongated and angular, the frontal compressed between the orbits, the palatopterygoids broadly lingulate, and the sagittal crest high; but the most important departure from its allies is found in the anterior part of the cranio-facial axis, and consists mainly in the broad articulation of the ascending wings of the palatine bones with the horizontal shelf of the orbitosphenoids, and in the presence of a fenestrum looking completely through the skull in front of the presphenoid. *G. bursarius* presents the extreme of differentiation occurring in the bisulcate series inhabiting the United States.

The following brief tabular statement of some of the cranial characters of the three members of the *tuza* group may facilitate the identification of specimens:

Differential cranial characters of the members of the tuza group.

	Mobilensis.	Tuza.	Floridanus.
Temporal impressions	United in a sagittal crest	Distant	Distant.
Frontal (interorbitally)	Very broad	Narrow	Narrow.
Ascending branches of premaxilla	Moderate	Moderate	Very broad and blunt.
Palatopterygoid	Narrow, sides parallel	Lingulate-cuneate	Lingulate cuneate.
Audital bullæ	Small	Small	Large.
Interparietal	Deeply notched posteriorly	Not notched	Not notched.

KEY TO SPECIES AND SUBSPECIES OF GEOMYS BY CRANIAL AND DENTAL CHARACTERS.

[Based on skulls of adult males only.]

(1) JUGAL *equal to or shorter than basioccipital* (measured from condyle).
- a^1 *Sagittal crest present.*
  - b^1 Zygomata strongly angular (standing out at right angles); jugal broadly rounded anteriorly.
    - Size large; audital bullæ normal .... *personatus*
    - Size medium; audital bullæ short and swollen (almost subglobular) *fallax*
  - b^2 Zygomata rounded; jugal narrow anteriorly; size small .... *sagittalis*
- a^2 *Sagittal crest absent.*
  - Temporal ridges prominent; squamosal arm of zygoma ending in a knob .... *arenarius*
  - Temporal ridges not prominent; squamosal arm of zygoma not ending in a knob .... *texensis*

(2) JUGAL *longer than basioccipital* (measured from condyle).
- c^1 *Sagittal crest strongly developed*—long and high; size largest ...... *bursarius*
- c^2 *Sagittal crest feebly developed or absent;* size medium or small.
  - d^1 Nasal bones hour-glass shaped; strongly constricted near middle.
    - e^1 Temporal impressions uniting in sagittal crest .... *mobilensis*
    - e^2 Temporal impressions not uniting in sagittal crest.
      - Audital bullæ small; not swollen; nasals broad posteriorly ..... *tuza*
      - Audital bullæ large, swollen; nasals narrow posteriorly ... *floridanus*
  - d^2 Nasal bones not hour-glassed shaped; slightly or not constricted near middle.
    - f^1 Frontal strongly depressed interorbitally; zygomata broadly rounded; nasals very narrow posteriorly, notched behind. *breviceps*
    - f^2 Frontal slightly or not depressed; zygomata angular, strongly divergent anteriorly.
      - Temporal ridges prominent, divergent anteriorly; nasals abruptly narrow and convex posteriorly .... *attwateri*
      - No temporal ridges; temporal impressions parallel or meeting in sagittal ridge; nasals truncate or emarginate posteriorly .... *lutescens*

GEOMYS TUZA (Ord).

(Frontispiece and pl. 7, fig. 1; pl. 13, fig. 9; pl. 15, fig. 12.)

Mus tuza Ord, Guthrie's Geog., 2d Am. ed., II, 1815, 292 (based on Mitchill's "undescribed little quadruped of Georgia"—see *postea*).

Geomys pinetis Rafinesque, Am. Monthly Magazine, vol. II, No. I, Nov., 1817, 45 (type of genus *Geomys*).

Undescribed little quadruped of Georgia, Mitchill, New York Medical Repository, V, 1802, 89. (Descr. orig. on which the name *Mus tuza* of Ord was based.)

Hamster of Georgia, Anderson, 2d Am. from 8th London ed. of Bewick's Hist. of Quadrupeds, 1848,* 326 (accompanied by figure with cheek pouches properly turned in).

Type locality.—Pine barrens near AUGUSTA, GEORGIA.†

Geographic distribution.—Pine barrens of Georgia (and probably northern Florida also), within the Austroriparian faunal area (map 4).

General characters.—Size medium or rather large; tail long and naked; feet moderately well haired; a small naked pad on end of nose.

Color.—Upper parts cinnamon brown, strongly tinged with fulvous in fresh pelage; only a faint trace of darker median dorsal stripe; under parts dull ochraceous buff; hairs of feet whitish.

Cranial characters.—Skull rather large and angular (Pl. 7, fig. 1), its upper surface convex in profile (due in part to the strongly decurved rostrum and in part to the absence of sagittal crest); zygomata divergent anteriorly, the maxillary root sloping strongly backward; temporal impressions never uniting in a sagittal ridge, but forming permanent temporal ribs, which in the males are elevated on both sides and separated by an interspace or sagittal area 3 to 4 mm. in width. In the females the interspace is broader and usually thickened so that it is flush with the top of the temporal impressions. Interparietal very large and broad. The frontal is narrow interorbitally; postorbital prominences marked; palatopterygoids lingulate-cuneate, the base slightly or not excavated on outer side; audital bullæ small, normal; basioccipital strongly wedge-shaped, truncate anteriorly.

Skulls of *G. tuza* may be distinguished from those of *mobilensis* by the presence of distant temporal ridges instead of a sagittal crest; by the narrow frontal (interorbitally); by the lingulate-cuneate (instead of narrow strap-shaped) palatopterygoids, and by the very large interparietal which is not notched behind (fig. 6 *e*). Skulls of *tuza* differ from those of *floridanus* in much narrower ascending branches of premaxillæ, broader nasals posteriorly, more strongly wedge-shaped basioccipital, and much smaller audital bullæ. The relationship with *floridanus* is much closer than with *mobilensis*. The profile of the top of the skull is more convex than in either of the others.

Measurements.—*Average* of ten males from type locality (Hollywood, Georgia, 12 miles south of Augusta): Total length, 269; tail vertebræ, 89.5; hind foot, 34.4.

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* The copy cited by Coues (Monographs of N. Am. Rodentia, 1877, 615 footnote) has the same pagination, but a somewhat different title page (different publisher) and is not dated. The eighth London edition of Bewick was published in 1824. The only mammals described in the American reprint not in the original are the grizzly bear, hamster of Georgia, and mammoth.

† The type specimen was sent Dr. Mitchill from Augusta, Ga., in July, 1801, by Josiah Meigs, president of the University of Georgia. In the letter that accompanied the specimen Mr. Meigs said: "For the space of about 100 miles, between Savannah and Augusta, the land on each side of the road is almost covered by the heaps of loose earth raised by it."—New York Medical Repository, V, 1802, 89.

Average of nine females from same place: Total length, 249; tail vertebræ, 82; hind foot, 32.

For cranial measurements see Table C, p. 208.

Specimens examined.—Total number 32: twenty from type locality, Hollywood, 12 miles south of Augusta, Georgia; and twelve from Butler, Georgia, (latter not typical).

General remarks.—Specimens from Butler, near the western border of Georgia, are intermediate between *tuza* and *mobilensis*. In color they resemble the latter, while in cranial characters they are nearer the former.

It is an interesting fact that the first description of this species—and not a bad description either, considering it was written nearly a century ago—was from the pen of a member of Congress, the Hon. John Milledge, Representative from Georgia. It was published by Dr. Mitchill in the New York Medical Repository in 1802 (vol. v, p. 89), and runs as follows: "One of the little animals that burrows in the pine land, only known in Georgia, was caught by Mr. Stephen Pierce, living midway between Savannah and Augusta. Its body is of the length and thickness of a common-sized rat, and of the same color: the head between that of a rat and a mole, with small whiskers and short snout: the tail without hair, but shorter than that of a rat: the fore feet like those of a mole, with nails near an inch long: the hind feet like those of a rat, but the nails not of the same length, each foot having five claws: very sparkling small eyes: also short ears: teeth like a squirrel, and full as long. On both sides of the jaw, externally, are sacks or wallets, where it deposits its food, and each will contain as much as can be put in a large tablespoon. Little or no fur, and the hair of the length of a wood rat. The whole face of the pine country is covered with little mounds made by this animal, of the circumference of a peck, and from 6 to 8 inches high. It is by no means active, but remarkably fierce. No common wooden place of confinement can hold it long, as it gnaws its way out. It lives entirely on roots, and is very fond of the sweet potato, and often proves injurious to the planter by getting under his stacks. It appears to move nearer the surface in the spring and fall than at any other season. It is surprising, that though the work of this creature is seen throughout the country, in the region of the long-leaf pine, and in that region only, yet such is its skill in burrowing, and acuteness of hearing, that there is no animal in all our State so seldom caught or seen."

GEOMYS TUZA FLORIDANUS (Aud. and Bach.).

(Pl. 7, figs. 3 and 4; Pl. 10, fig. 1; Pl. 14, fig. 16.)

Pseudostoma floridana Aud. and Bach., Quadrupeds of North Am., Vol. III, 1854, 242-245.

Geomys tuza Goode (not Ord), Powell's Report Colorado River, 1875, 281-285 (habits).

Type locality.—ST. AUGUSTINE, FLORIDA.*

*Audubon and Bachman *did not* discriminate between the Georgia and Florida animals, *but all of their Florida* specimens came from St. Augustine.

General characters.—Similar to *G. tuza*, but much darker in color; fore feet larger; tail slightly more hairy; differs also in cranial characters.

Color.—Upper parts dull sooty-plumbeous, becoming cinnamon-drab on the sides; under parts plumbeous, more or less washed with buffy; an irregular white patch under chin and throat.

Cranial characters.—Skull long, with very angular zygomatic arches, much as in *tuza* and *mobilensis*. *G. floridanus* differs from *G. tuza* in broader and blunter ascending branches of premaxilla, narrower nasals posteriorly, somewhat broader jugals anteriorly, more rectangular (less strongly wedge-shaped) basioccipital, and much larger audital bullæ; from *mobilensis* in much larger audital bullæ, narrower frontal, less spreading and more depressed arches, much broader ascending branches of premaxilla, less flattened brain case, lingulate-cuneate instead of narrow palatopterygoids, and in the presence of temporal ridges instead of a sagittal ridge. The angular process of the mandible is much less deeply notched at base anteriorly. In *G. floridanus* the interspace between the two grooves of the upper incisor is broader than in either *tuza* or *mobilensis*, and the head of the jugal is more deeply mortised into the maxillary arm of the zygoma.

Specimens examined.—Total number 25, from the following localities in Florida: Chattahoochee, 2; Pomona, 4; Gainesville, 1; San Mateo, 6; Tarpon Springs, 12.

Measurements.—Average of three males from San Mateo, Florida (measured in flesh by Dr. W. L. Ralph): Total length, 288; tail vertebræ, 94; hind foot, 35.5. Average of three females from same locality: Total length, 235; tail vertebræ, 77; hind foot, 33. For cranial measurements see Table C, p. 208.

General remarks.—The foregoing description has been drawn up from specimens from San Mateo, Putnam County, Florida,* only 25 miles from St. Augustine, the type locality of the species. Specimens from further south on the peninsula are somewhat different.

The best and almost the only authentic account of the habits of this species is from the pen of the eminent director of the U. S. National Museum, Dr. G. Brown Goode, by whom it was contributed to Coues' monographic paper on the group, published in 1875.† Dr. Goode kept a number in confinement for several weeks and was thus enabled to make the following interesting observations on their habits. He says: "They may easily be confined in a wooden box, with sides 8 or 10 inches high, having dry sand 2 or 3 inches deep on the bottom. No cover is necessary; I have never seen one look up from the earth, and have

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*These specimens were kindly presented to me by Dr. W. L. Ralph, of Utica, New York, who collected them himself and measured them in the flesh.

†Abstract of results of a study of the genera *Geomys* and *Thomomys*. Powell's Expl. Colorado River, 4°, 1875, 215–285. Addendum B.—Notes on the "Salamander" of Florida, by G. Brown Goode, 281–285.

rarely known them to attempt to escape. They require no water, and no food except sweet potatoes. A single potato of moderate size will feed a salamander for three days.

"The senses of sight and hearing seem in them to be very dull. An object may be held within a short distance of their eyes without attracting their attention; but the moment one is touched, he turns with a jump, snapping fiercely, much to the detriment of fingers which may be near. If two are confined in the same cage, the one does not seem aware of the presence of the other, unless they accidentally come in contact. Their eyes are small, dull, and without expression. Their sense of smell I judge to be very delicate, from the manner in which they approach the hills of potatoes. Their motions are surprisingly quick and energetic, their activity never ceasing from morning to night.

"They are very pugnacious, and a rough-and-tumble combat between two vigorous males would seem terrific, if their size could be magnified a few diameters in the eye of the spectator. Every muscle of their compact, elastic, stout bodies is brought into action, and they plunge and bite with wonderful ferocity. A battle is usually followed by the death of one or both. I have examined them after death and found the whole anterior part of the body bruised almost to the consistency of paste, the bones of the legs crushed in four or five places. When two come together in the cage, their salutation is a plunge and a bite.

"I watched their burrowing with much interest. They dig by grubbing with the nose and a rapid shoveling with the long curved fore paws, assisted by the pushing of the hind feet, which remove the dirt from beneath the body and propel it back with great power a distance of 8 or 10 inches. When a small quantity of earth has accumulated in the rear of the miner, around he whirls with a vigorous flirt of the tail and joining fore paws before his nose, he transmutes himself into a sort of wheelbarrow, pushing the dirt before him to a convenient distance, and repeating the act until the accumulation is removed, then resuming his mining. Any root or twig which blocks his way is quickly divided by his sharp chisel-teeth. * * * The direction of the burrows may easily be traced by the loose hillocks of white sand which are thrown up along the line at intervals of 3 or 4 feet. These are the 'dumps' made by the burrower in throwing out his refuse accumulations. Each consist of about a peck of loose sand, and, by the casual observer, might easily be mistaken for an ant-hill. No opening is visible, but by digging under the hill a hole is found, the mouth of the adit to the main tunnel, which may be 3 feet below the surface if made in cold weather, but perhaps not more than 6 inches if in summer. One of the mounds is thrown up in a very few moments. I have seen 30 raised in a single night on the line of one tunnel; this would represent nearly 100 feet of tunneling. I have seen 150 in one continuous row raised in about two days; this would make between 400 and 500 feet of burrow completed in that short time, apparently by one little animal, an amount of work which may seem incredible to one who has not watched the restless movements of these animated plows, which are seemingly as well adapted for piercing the sand as birds are for cleaving the air. The burrows are about 2½ inches in diameter. * * * The nests are large chambers, 1 or 2 feet from the main tunnel, with which they are connected by side passages, which leave nearly at right angles. Here the miners lay up a supply of provisions and the chambers are often found to contain a half bushel of sweet potatoes cut up into chunks as large as peach stones, and of convenient size to be carried in the pockets. * * * In these side chambers the salamanders rear their young, building a nest of grass, pine needles, and live-oak leaves. I found them breeding in April."

Dr. Goode remarks that the name 'salamander,' by which the species is universally known in the South, "may allude to the safety enjoyed by these little animals in their subterranean abodes at the time of the devastating fires which sometimes consume the pine forests. After such a conflagration has passed over their heads, destroying every other kind of life, they are seen at work among the ashes, very good types of the salamander of fable."

Mr. Morris M. Green, who obtained specimens for the Division at Pomona, Putnam County, Florida, in June, 1889, furnished the following notes respecting their habits: "The hills of the 'salamander,' as the Florida *Geomys* is called, are abundant in the pine woods and clearings, on rather low and moist land. Their tunnels were from 4 to 24 inches below the surface; the hills were thrown up at intervals of from 2 to 6 feet, and contained about a peck of dirt each. The night and early morning seemed to be their favorite time for working. It is very easy to trap a 'salamander' when fresh mounds are found. By sweeping to one side the heaps of dirt, traces of the hole through which the earth was brought and its direction can be easily found. A minute's work with the spade will usually expose the tunnel lying to one side of the hill. Place a steel trap in the tunnel, and cover up the breach with a piece of pine bark or some palmetto 'fans.' If the breach is left open, the animals will carry dirt to shut out the light, and thus clog the trap, whereas if the opening is closed they will step in the trap and are caught. A break is often repaired within half an hour, or it may be left for nearly a day. In mending an opening it is astonishing how compactly the earth is packed; in one case an animal closed an opening so securely that the tunnel could not be found at all until another shaft was sunk in search of it.

"A 'salamander' caught in a trap is a picture of fury and spite, biting at everything within reach of its jaws, and sometimes breaking its front teeth in venting its rage on a trap.

"In the cheek pouches of one were some pieces of pine roots, and some grasses were found in the tunnels. The animals do serious injury to orange and pear trees by gnawing the roots. Sometimes the roots are gnawed off so completely that the tree can be pushed over with one hand. They also feed on sweet potatoes. But when an animal enters a garden or an orchard, and betrays itself by throwing up hills, there is no excuse for not ridding the place of it, as it may be easily caught in a steel trap. It is claimed that the 'salamander' works near the surface from September to March, retiring deeper in the ground during the hot season."

GEOMYS TUZA MOBILENSIS subsp. nov.

(Pl. 7, figs. 2, 5, and 6; pl. 10, fig. 2; pl. 14, fig. 15; text fig. 6, *f* and *g*.)

Type from MOBILE BAY, ALABAMA. No. [illegible] ♂ ad. U. S. Nat. Museum, Department of Agriculture collection. Collected April 26, 1892, by Russell J. Thompson. (Original No. 50.)

Geographic distribution.—Southern Alabama and adjacent part of northwest Florida, within the Austroriparian zone (map 4).

General characters.—Similar to *G. tuza*, but somewhat smaller, and much darker in color; tail shorter, nearly naked; feet scant haired.

Color.—Upper parts dark, generally sepia or bistre, washed on sides of face and body with golden brown or ochraceous, intimately mixed with black-tipped hairs; top of head, between eyes and including ears, dusky, with an ill-defined dorsal band of the same color. Under parts dark plumbeous, faintly washed with dull pale fulvous. Hairs of feet whitish. More or less white about throat and pouches.

Cranial characters.—Skull very long and angular (pl. 7, fig. 2); frontal broad and high; top of skull in profile strongly convex; zygomatic arches broadly spreading, divergent anteriorly, and angular; brain case broad and flat; palatopterygoids narrow, their sides parallel; temporal impressions in adult males meeting in a low but well-developed sagittal ridge; interparietal deeply excavated posteriorly (trousers-shaped), reduced in advanced age by meeting of temporal ridges (fig. 6, *f* and *g*). *G. mobilensis* differs from *G. tuza* in the great breadth of the frontal interorbitally; the narrow palatopterygoids; the presence of a sagittal ridge in adult males, and the very different shape of the interpariteal (fig. 6). It differs from *floridanus* in much smaller audital bullæ, broader frontal, lower and more depressed brain case, more divergent zygomatic arches, narrower ascending branches of premaxilla and much narrower palatopterygoids. *G. mobilensis* differs from *G. breviceps*, its nearest neighbor on the west, in general form of the skull and in numerous details: in profile the top of the skull is strongly convex instead of concave; the zygomatic arches are more angular and more divergent anteriorly; the frontal is much broader interorbitally; the brain case flatter; the nasal bones broader and constricted in front of the middle; the angular process of the mandible deeply notched anteriorly.

Measurements (taken in flesh).—*Type* specimen: Total length, 260; tail vertebræ, 82; hind foot, 33.

Average of four males from type locality: Total length, 250; tail vertebræ 81; hind foot, 33.5.

Average of four females from same place: Total length, 229; tail vertebræ, 76; hind foot, 30.5.

For cranial measurements see Table C, p. 208.

Specimens examined.—Total number 23: 9 from Point Clear, Mobile Bay, Alabama, 2 from Brewton, Alabama, and 12 from Milton, Florida.

General remarks.—*Geomys mobilensis* is an inhabitant of the lowlands bordering the Gulf of Mexico east of Mobile Bay. How far its range extends to the east and north has not been ascertained. In size and coloration it seems to bear the same relation to its neighbor (*G. tuza*) of the adjacent pine barrens of Georgia that *G. breviceps* of the lowlands of Louisiana and Texas bears to its relative of the higher and drier ground further west (*G. lutescens*).

It seems a pity that such a strikingly marked animal as *mobilensis* must stand as a subspecies, but there is no reasonable doubt of its complete intergradation with *tuza* in western Georgia.

GEOMYS BURSARIUS (Shaw).

(Pl. 1; pl. 9, figs. 8 and 9; pl. 10, fig. 6; pl. 13, fig. 11; pl. 14, fig. 2; pl. 15, fig. 11; pl. 17, fig. 3; pl. 18, fig. 1; pl. 19, fig. 3; text fig. 55.)

Mus bursarius Shaw, Trans. Linnean Soc., v. 1800, 227-228, pl. 8; Genl. Zoology, Mammalia, Vol. II, pt. 1., 1801, 100-101, pl. 138.

? *Mus ludovicianus* Ord. Guthrie's Geography, 2d Am. ed., 1815, 292 (*Nomen nudum*).

Diplostoma fusca Rafinesque, Am. Monthly Magazine, Vol. II, No. I, Nov. 1817, 45.

Geomys cinerea Rafinesque, Am. Monthly Magazine, Vol. II, 1817, 45. (*Mus bursarius* renamed.)

Saccophorus bursarius Kuhl, Beiträge zur. Zool., 1820, 65.

Mus saccatus Mitchill, New York Medical Repository, Vol. VI, n. s., 1821, 249. (Type from Lake Superior, probably Minnesota.)

Pseudostoma bursarius Say, Long's Expd. to Rocky Mts., I, 1823, 406.

Ascomys canadensis Licht., Abh. Akad. Wiss. Berlin (1822), 1825, 20, fig. 2.

Geomys? bursarius Richardson, Fauna Boreali-Americana, I, 1859, 203.

Geomys canadensis LeConte, Proc. Acad. Nat. Sci., Phila., VI, 1852, 158.

Geomys oregonensis LeConte, Proc. Acad. Nat. Sci., Phila., VI, 1852, 160. (Locality erroneous.)

Type locality.—Unknown; somewhere in Upper Mississippi Valley.

Geographic distribution.—Upper Mississippi Valley from a short distance south of the Canadian boundary, in longitude 97° (Warren, Minnesota, and Grand Forks, North Dakota), southward to eastern Kansas (Neosho Falls), southeastern Missouri (Williamsville and Hunter), and southern Illinois (Belleville); east nearly to Lake Michigan (Winnebago and Fond du Lac, Wisconsin, and Cook County, Illinois); west in the Dakotas and Nebraska to the ninety-eighth or ninety-ninth meridian (Valley City and Hamlin, North Dakota; Burch, Mitchel, and Scotland, South Dakota; Niobrara, Ericson, and Kearney, Nebraska). The species belongs to the Upper Sonoran and Transition zones. See map 4, B.

General characters.—Size large; coloration dark; tail medium or rather long, scant haired, the terminal half nearly naked.

Color.—Dark liver brown or chestnut above and below, somewhat paler on the belly (belly very rarely whitish); fore feet white; hind feet soiled white; hairs of tail usually brown on basal part and white on terminal part.

Cranial characters.—Skull long, large, and angular (pl. 1); zygomata spreading, widely divergent anteriorly, angular; a well-developed sagittal crest; rostrum long and narrow for size of skull; frontal narrow and rounded interorbitally; palatopterygoids broadly lingulate, tapering posteriorly, not notched at base on outer side (pl. 14, fig. 2). The skull of *G. bursarius* does not require close comparison with any other species, though the young and females are sometimes difficult to distinguish from *lutescens.* The skull of the female differs from that of the male in much smaller size, shorter rostrum, broader interorbital region, fuller brain case, in the absence of distinct sagittal and lambdoidal crests, and in the less development of processes and ridges for muscular attachment. Skulls of *G. bursarius* differ from those of *lutescens* chiefly in greater length and angularity, the ratio of zygomatic breadth to basilar lenth of Hensel rarely exceeding 73 percent in adults; while in *lutescens* this ratio runs from 75 to 79. The brain case is higher posteriorly and the sagittal crest is much more highly developed. *G. bursarius* (in common with *lutescens*) differs from *personatus* notably in the angle of the anterior part of the zygomatic arch and in the length of the jugal. In both *bursarius* and *lutescens*, even in old age, the anterior root of the zygoma slopes back at a considerable angle; in *personatus* it stands out at nearly a right angle. In *bursarius* and *lutescens* the jugal is much longer than the basioccipital; in *personatus* it only equals the basioccipital.

Dental characters.—Face of upper incisors strongly bisulcate; small sulcus fine and close to inner edge of tooth; principal sulcus much larger and on or slightly external to median line; enamel face rounded externally and between sulci (fig. 22^2, and pl. 15, fig. 11). Molariform teeth much smaller than in the other sections of the genus; crown of last upper molar suborbicular, without heel.

Upper molariform series.—The upper premolar curves and slopes strongly forward and is concave anteriorly; the last molar curves strongly backward and is concave posteriorly. The intermediate molars curve both backward and outward; the first only slightly backward, the second strongly; both are concave externally; their roots divaricate, the first sloping forward, the second backward. (A second and greater point of divergence is between the premolar and first molar.) The premolar is nearly one-third longer than the last molar. The intermediate teeth are about as long as the premolar—sometimes longer.

Lower molariform series.—All the teeth are short compared with those of the upper series; premolar longest, largest, heaviest, and curves strongly forward; last molar smallest, shortest, and curves strongly backward; the intermediate teeth intermediate in length. Premolar strongly concave anteriorly and nearly as concave outward; m_1 slightly concave anteriorly, strongly concave outward, and somewhat twisted on its axis; m_2 strongly concave outward and faintly anteriorly, with a slight twist; m_3 strongly concave posteriorly and moderately so outwardly.

Average measurements of 26 specimens of both sexes from eastern North Dakota (measured by J. Alden Loring): Total, 270; tail vertebræ 80; hind foot, 35. Average of 6 males from same localities: Total, [illegible]; tail vertebræ, 90; hind foot, 37. Average of 10 females: Total, [illegible]; tail vertebræ, 78; hind foot, 34. Average total length of 20 males and 20 females from Elk River, Minnesota, measured in flesh by Vernon Bailey: Males, 284; females, 243. In both cases many of the specimens are not full grown, hence the measurements are toc small. Unfortunately no satisfactory series of measurements is available.*

For cranial measurements see Table A, p. 204.

General remarks.—Geomys bursarius is a well-marked species, easily distinguishable by color alone from all the other bisulcate forms. It is also the largest species inhabiting the United States, although varying considerably in size in different localities. The largest form inhabits the region about Knoxville, Iowa, where the males average a foot in length.

Geomys bursarius is of much greater economic consequence than all the other species combined, for the reason that its home is in the fertile prairie region of the Mississippi Valley from central Missouri northward, covering the whole State of Iowa, nearly the whole of Illinois, and the richest and most densely populated agricultural lands of eastern Kansas, eastern Nebraska, eastern South and North Dakota, Minnesota, and southern Wisconsin.

Specimens examined.—Total number 116, from the following localities:

North Dakota: Portland, 18; Erie, 3; Casselton, 2; Buffalo, 2; Valley City, 3.

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*Dr. C. E. McChesney, U. S. Army, in a paper on the Mammals of Fort Sisseton, Dakota, has recorded a valuable series of measurements of this species, all taken at that locality. While his measurements are not strictly commensurate with ours, and while many of his specimens were not full grown, his means are important, particularly as showing the average sexual difference. Reduced to millimeters his most important means are:

Mean of—	Head and body	Tail vertebræ	Hind foot
Thirty-three males, Fort Sisseton, South Dakota	214	79	[illegible]
Thirty-five females, Fort Sisseton, South Dakota	182	72.5	[illegible]
Sixty-eight specimens, both sexes	198	76	[illegible]

(Bull. U. S. Geol. and Geog. Survey, Terr. IV, No. 1, Feb., 1878, p. 213.)

South Dakota: Flandreau, 1; Fort Sisseton, 1; Travare, 2; Scotland, 1.

Minnesota: Ortonville, 2; Browns Valley, 1; Elk River, 39.

Iowa: Council Bluffs, 1; Knoxville, 16.

Nebraska: Niobrara, 3; Verdigris, 1; Columbus, 1; Ames, 1; Blair, 1; Norfolk, 2.

Kansas: Onaga, 3.

Missouri: Hunter, Carter County, 4; Williamsville, Wayne County, 8.

EARLY HISTORY OF GEOMYS BURSARIUS.

The early history of this gopher is somewhat obscure. It was originally described by Shaw in the year 1800 and was named *Mus bursarius*.* The description is very brief and is as follows: "Ash-coloured rat, with short round nearly naked tail, pouched cheeks, and the claws of the forefeet very large, formed for burrowing in the ground." Shaw states further: "This quadruped was taken by some Indian hunters in the upper parts of interior Canada, and sent down to Quebec. It is now in the possession of Governor Prescot." The description is accompanied by a full-size engraving of the animal, with cheek pouches turned inside out and distended. The skin evidently was greatly overstuffed. No grooves are shown on the upper incisors.

The next year (1801) Shaw redescribed the same specimen as follows: "It is about the size of a brown or Norway rat, and is of a pale greyish-brown colour, rather lighter beneath; the length to the tail is about 9 inches, and that of the tail, which is but slightly covered with hair, about 2 inches: the legs are short; the fore feet strong, and well adapted for burrowing in the ground, having five claws, of which the three middle ones are very large and long; the interior much smaller, and the exterior very small, with a large tubercle or elbow beneath it. The claws on the hind feet are comparatively very small, but the two middle are larger than the rest, and the interior one is scarce visible: the teeth are extremely strong, particularly the lower pair, which are much longer than the upper: the ears are very small." (General Zoology, vol. II, part 1, Mammalia, 1801, pp. 100–101.) He gave a new engraving of the animal, stating that in the figure previously published (in the Transactions of the Linnean Society) "the claws on the fore feet are represented as only three in number, and are somewhat too long, weak, and curved. The engraving in the present plate is a more faithful representation, and is accompanied by an outline of the head, in its natural size, as viewed in front, in order to shew the teeth and cheek-pouches." This plate contains three figures: a side view, as in the earlier engraving; a front view, reduced, and a natural-size front view in outline. The cheek pouches are everted, as before, protruding from

*Transactions of the Linnean Society, London, vol. V, 1800, pp. 227–228; description read before the society June 4, 1799.

the sides of the face as great bursæ. Although the teeth are distinctly shown in these engravings, no trace of a groove is apparent, unless an incomplete dotted line near the middle of each upper incisor in the outline figure was intended to indicate it. The size of the incisors in this figure agrees exactly with the size of these teeth in specimens of *Thomomys talpoides* from Manitoba, and the size and shape of the fore feet and claws are as in *Thomomys*, thus differing widely from the same parts in *Geomys*, in which the teeth and claws are very much larger and heavier.

The color of the body (which he describes as "pale greyish-brown, rather lighter beneath"), the size and shape of the forefeet and claws, the size of the incisors, the absence of the deep median furrow so conspicuous in *Geomys* (which could hardly have been overlooked both in the description and figure), together with the statement that the animal came from the interior of Canada, all indicate that the species now known as *Thomomys talpoides* was the animal Shaw had before him.

The only point mentioned by Shaw in either of his descriptions of the type specimen of '*Mus bursarius*' that does not apply strictly to *Thomomys*, to the exclusion of *Geomys*, is the length of the animal, which he gives as 9 inches. This is easily explained on turning to the figure, which shows the specimen to be greatly overstuffed—a common error in taxidermy resulting from the exceedingly loose and distensible skins of these animals, which are nearly always stretched in taking off from the body.

Recapitulating, Shaw's description and figures seem to establish the following points:

(1) The type specimen of *Mus bursarius* came from the "upper parts of interior Canada," the home of *Thomomys*. No member of the genus *Geomys* reaches Canada, its northernmost known point being Warren, Minnesota.

(2) The type specimen of *Mus bursarius* was "ash coloured" or "pale greyish-brown, rather lighter beneath," exactly as in *Thomomys*. The color of the only species of *Geomys* inhabiting the Upper Mississippi Valley is dark chestnut or liver-brown, both above and below.

(3) The detailed description given by Shaw in his General Zoology makes no mention of grooves in the incisors, though these teeth are described with particularity. In *Geomys* the upper incisors are deeply furrowed; in *Thomomys* they are plane.

(4) Not one of the four figures of the type specimen of *Mus bursarius* published by Shaw shows any trace of the grooved incisors of *Geomys*, and two of these figures are front views, one natural size.

(5) The size of the teeth, fore feet, and claws in Shaw's natural-size figure agree with these parts in Manitoba specimens of *Thomomys* and are very much smaller than in *Geomys*.

From the above facts it would appear that the animal described by Shaw under the name *Mus bursarius* is the gray pocket gopher of Man-a and the Dakotas (*Thomomys talpoides* of recent authors) and not red pocket gopher of the Mississippi Valley (*Geomys bursarius* of at authors). This view would necessitate a slight change in nomen-are: *Thomomys talpoides* Auct. would become *Thomomys bursarius* w), and *Geomys bursarius* Auct. would become either *Geomys fuscus* inesque) 1817, or *Geomys saccatus* (Mitchill) 1821.* Fortunately no ge in the generic name would be required, since Rafinesque based enus *Geomys* on *G. pinetis* [= *G. tuza*] of the pine barrens of Georgia. ear as the case seems to have been left by Shaw, it became shrouded scurity by the writings of subsequent authors.

1820 Heinrich Kuhl published his Beiträge zur Zoologie, in which escribed the genus *Saccophorus*, basing it on the *Mus bursarius* of w. He states that the specimen examined by him was formerly ullock's Museum, but then in Paris ("in Museo Bullokiano, nunc isiensi," p. 65), but does not intimate that it was Shaw's specimen. he diagnosis of the genus he states that the upper incisors have sulci, of which the external is broader and deeper, thus describing condition in typical *Geomys*.

ichtenstein, in a paper written in 1822, but not published until 1825, s: "When I was in London in the summer of 1819 I saw in the lock collection the specimen described by Shaw" (Überäussere Back-aschen an Nagethieren, Abh. K. Akad. Wiss. Berlin [for 1822], 1825, 5). He then goes on to describe another specimen, assumed to ng to the same species, which he says he had recently received a North America.

he first positive statement I have been able to find to the effect that w's specimen had grooved incisors was made by Richardson more a quarter of a century after the publication of Shaw's last descrip-. Richardson states that the engraving of Shaw's *Mus bursarius* lished in the Linnean Transactions was drawn by Maj. Davies,† that "the specimen figured by Major Davies, in the Linnean Trans-ons, was of a pale gray colour, and 9½ inches long from the nose to root of the tail, which measured 2½ inches. The belly was paler a the back, and the cheek-pouches were covered with very short hairs. Its superior incisors were deeply grooved in the middle, more faintly close to their inner margins" (*Ibid.*, 203). As to the l disposition of this specimen he says: "The identical specimen

Diplostoma fusca Rafinesque, Am. Monthly Mag. II, 1817, 45, is little more than *men nudum*, the only specific description being "entirely brown, length 12 es." But the generic diagnosis, though full of errors, leaves no doubt as to the al; and the locality assigned, "Missouri Territory," is sufficiently exact in con-ion with the size and color of the species. If, however, this name is not con-ed available, the next in point of date seems to be *Mus saccatus* Mitchill, Medi-Repository, vol. VI, 1821, 248-250; type "from the region bordering on Lake rior," doubtless Minnesota, where the animal is abundant. The bisulcate upper ors are described in detail by Mitchill.

†Fauna Boreali-Americana, 1829, 199.

described by Shaw, * * * on the dispersion of Mr. Bullock's collection, passed into the hands of M. Temminck" (*Ibid.*, p. 199).

That this particular specimen is now in the Leiden Museum is certain, for it is mentioned by Dr. F. A. Jentink, the able director of the Rijks Museum, in his *Catalogue Systématique des Mammifères*, XII, 1888, p. 93. In response to a letter of inquiry, Dr. Jentink has had the kindness to write me as follows: "On the underside of the stand [of the specimen above mentioned] I see the following words written with pencil: 'Mus bursarius, Cabinet Bullock, Londres.' So you may be sure of the fact that this specimen truly has been bought from Bullock's auction. As to the animal itself and its identity with Shaw's description, you may judge if I tell you that it has the cheek pouches turned inside out and distended, but not in the extraordinary way as represented in Shaw's figure 138, vol. II, p. 1. The incisors are deeply grooved. Shaw's figure represents, without doubt, an overstuffed specimen; meanwhile our specimen seems to be in excellent proportions and very well-preserved condition. Length of the animal, 9.8 inches, measured from the upper lip along the dorsal line of the body; tail about 2.8 inches. The color of our specimen is a desert color, more reddish toward head and hinder parts of the body."

In 1857 Baird made the following statement, evidently based partly on the remarks of Richardson, already quoted, and partly on an erroneous translation of the statements of Kuhl and Lichtenstein. Baird says: "The same skin referred to by Shaw was subsequently investigated by Kuhl, and then by Lichtenstein. It was for a time in the celebrated museum of Mr. Bullock, of London, and is said to have been purchased by Temminck at the sale of this collection, and is doubtless now in the Leyden Museum." (Mammals of North America, 1857, 376.) But Kuhl does not say that his specimen was the same as Shaw's, and Lichtenstein distinctly states that the animal described by him was not Shaw's specimen (which he says he saw in London in 1819), but one that he "received a short time ago with other North American mammals."

If it is true that the specimen described by Kuhl is really the same as that described by Shaw twenty years earlier, and afterwards mentioned by Lichtenstein as having been seen by him in London in 1819, it would be certain that no other animal than the furrowed-toothed pocket gopher of the Upper Mississippi Valley (*Geomys*) could be meant. But unfortunately Kuhl says nothing on this point, and it must be admitted that the conspicuous discrepancies between his description and Shaw's are hard to reconcile on the assumption that they refer to the same specimen. Shaw says the body of his animal as stuffed measured 9 inches, and the tail 2 inches. Kuhl says the body measured 7½ inches, and tail 2⅓ inches. Shaw described his animal as "ash-coloured," and "pale greyish-brown," while Kuhl says that his inclined to rufous ("rufescens")—the proper color for Geomys.

Is it not possible that Richardson, in translating the Latin of Kuhl or the German of Lichtenstein, fell into the same error as Baird? At all events it should not be forgotten that Richardson wrote nearly thirty years later than Shaw—an interval sufficiently long to allow additional specimens to reach England and also to favor slips of memory. It should be further remembered not only that Lichtenstein had a specimen additional to that described by Shaw, but also (and much more important) that there appears to be no ground for the assumption that Kuhl's description was taken from Shaw's specimen; in fact the marked discrepancies between them seem to prove the contrary, as pointed out above.

Shaw's and Richardson's descriptions are utterly irreconcilable on the assumption that they refer to the same specimen, but would be perfectly intelligible if it can be shown that a second specimen found its way into the Bullock collection between the years 1800 and 1819.

The matter is still further complicated by Richardson himself, who, writing in 1831, says: "We lately received several specimens of the *Mus bursarius* of Shaw (which is a true *Geomys*, with pouches opening internally) from the banks of the Saskatchewan." (Zoology of Beechey's Voyage of the Blossom, 1839, 9.) This statement shows that Richardson's ideas respecting the status and distribution of the several members of the group were badly confused, for it is now well known (as before stated) that no species of *Geomys* reaches the plains of the Saskatchewan; indeed the genus has not been found to enter Canada at all. The use of the generic name *Geomys* by Richardson, however, has no significance, since he applied the name to *Thomomys* as well as *Geomys*, and it is certain that his Saskatchewan animal is *Thomomys talpoides* Auct. His identification of the species with *Mus bursarius* of Shaw would be in accord with my belief that Shaw's animal could have been no other than the common *Thomomys* of Manitoba and the northern plains generally, except for his previous statement, already quoted from Fauna Boreali-Americana, that the Bullock specimen had grooved incisors and was the identical specimen described by Shaw. These conflicting statements by the same author I am utterly unable to reconcile.

GEOMYS LUTESCENS Merriam.

(Pl. 9, figs. 5 and 7; pl. 14, fig. 14.)

Geomys bursarius lutescens Merriam, N. Am. Fauna, No. 4, Oct. 8, 1890, 51.

Type locality.—Sand hills on BIRDWOOD CREEK, LINCOLN COUNTY, WESTERN NEBRASKA. (Type in U. S. National Museum.)

Geographic distribution.—The Upper Sonoran belt of the Great Plains from southwestern South Dakota southward to Colorado, Texas, covering the sand-hill region of western Nebraska, extreme eastern Wyoming (between the North Platte and Cheyenne rivers) western Kansas, eastern Colorado, western Oklahoma, and western Texas, ranging east to or a little beyond the ninety-ninth meridian (map 4, C).

General characters.—Size medium or rather large; coloration pale; tail moderate; scant haired; skull short.

Color.—Upper parts in winter drab, liberally mixed with black-tipped hairs along the median line, forming a distinct dorsal band from end of nose to rump; in summer pale buffy-ochraceous or very pale dull fulvous without dorsal band. Under parts buffy, usually white in the young and sometimes white in adults. Along the eastern and southern limits of its range the upper parts are decidedly more fulvous than in the typical animal.

Cranial characters.—Skull intermediate in size between *breviceps* and *bursarius;* zygomata broadly and squarely spreading, strongly divergent anteriorly; nasals normally elongate wedge-shaped, as in *bursarius*, but sometimes broadening in posterior third; temporal impressions normally uniting, at least posteriorly, in a low sagittal ridge (pl. 9, fig. 7), but sometimes remaining apart, separated by an interspace 1 to 3 mm. broad (pl. 9, fig. 5) [this form is commonest in the southwestern part of the range of the species]; interparietal varying from subquadrate in the young to subtriangular in adults, its size decreasing with age and the posterior suture becoming obliterated by ankylosis with the supraoccipital; palatopterygoids usually lingulate and tapering posteriorly as in *bursarius*, but somewhat narrower and sometimes strap-shaped.

Skulls of *Geomys lutescens* differ from those of *G. bursarius* chiefly in smaller size, greater relative breadth and flatness (the brain case as well as the rostrum being considerably shorter than in true *bursarius* from the Mississippi Valley), and in lacking the high sagittal crest of *bursarius*. Old skulls of *lutescens* have strongly spreading zygomatic arches which are very much broader anteriorly than posteriorly, and as a rule the premaxilla extends a little further back than in *bursarius*.

Skulls of *lutescens* bear a strong resemblance to those of *breviceps*, from which they differ in having the frontal region less depressed; the zygomatic arches more squarely spreading and more decidedly angular anteriorly; the nasal bones broader posteriorly; the ascending branches of the premaxilla longer and less blountly rounded posteriorly; the temporal impressions normally meeting posteriorly in a low sagittal ridge instead of remaining distant; the occiput more truncate (less bulging) posteriorly; the rostrum normally broader.

The cranial characters that distinguish *lutescens* from *texensis, arenarius*, and *personatus* are mentioned under the heads of these species.

Measurements.—Average of 28 specimens of both sexes from western Nebraska: Total length, 256; tail vertebræ, 77; hind foot, 32. Average of 12 males: Total length, 270.5; tail vertebræ, 84; hind foot, 33.5. Average of 10 females: Total length, 246; tail vertebræ, 72; hind foot, 31.5.

For cranial measurements, see Table A, p. 204.

Specimens examined.—Total number of typical or nearly typical specimens 118, from the following localities:

South Dakota: Pine Ridge Agency, 2; Rosebud Agency, 3.

Nebraska: Chadron, 1; Kennedy, 13; Valentine, 3; Ewing, 2; Oakdale, 2; Crawford, 1; Snake River, Cherry County, 1; Clarks Canyon, Cherry County, 7; Dismal River, Thomas County, 1; Niobrara River, Sheridan County, 1; near North Platte, Lincoln County, 4; Birdwood Creek, 1; Myrtle, 3; Sidney, 1; Calloway. 4· Kearney, 1.

Wyoming: Lusk, 3; Uva, 1.

Colorado: Las Animas, 6; Denver, 1; Pueblo, 4; Limon, 3; Burlington, 1; Chivington, 6.

Kansas: Trego County, 3.

Oklahoma: Woodward, 3.

Texas: Canadian, 5; Tascosa, 4; Newlin, 3; Childress, 12; Vernon, 9; Colorado, 3.

Number of non-typical specimens 18, from the following localities:

Kansas: Garden Plain, 4; Belle Plain, 5; Cairo, 6; Kiowa, 2; Ellis, 1.

General remarks.—*Geomys lutescens* is a pallid species inhabiting the arid plains west of the ninety-ninth meridian. Its characters are very constant throughout most of its range, and if it intergrades with *bursarius* it must do so in the narrow strip between the ninety-eighth and ninety-ninth meridians. In southeastern Kansas an aberrant form exists that seems to be an intergrade between the three types, *bursarius*, *lutescens* and *breviceps*, but a larger series of specimens than at present available is needed to prove it. This animal is smaller than *lutescens*, nearly as dark above as *bursarius*, and paler below than either. Some specimens indeed have the belly pure white, as in *texensis*. Specimens of this apparently intermediate form (mostly immature) have been examined from Cairo, Kiowa, Garden Plain, and Belle Plain, Kansas.

Mr. Vernon Bailey states that in western Nebraska, where typical *lutescens* is abundant, the light sandy soil is probably improved by their diggings, but that they do considerable damage in grain fields and to young trees on the tree claims.

GEOMYS BREVICEPS Baird.

(Pl. 9, fig. 6.)

Geomys breviceps Baird, Proc. Acad. Nat. Sci. Phila., VII, April, 1855, 335.

Type locality.—PRAIRIE MER ROUGE, MOREHOUSE PARISH, LOUISIANA.

Geographic distribution.—The alluvial lowlands of the Mississippi Valley and Gulf coast in southern Arkansas, Louisiana, and Texas, and the valley of the Arkansas River; north nearly to southern Kansas, and west to near the ninety-eighth meridian, where it is replaced by *G. lutescens*. It is therefore a member of the Austroriparian fauna (map 4 D).

General characters.—Size small; color very dark both above and below; tail of medium length, its distal half nearly naked.

Color.—Upper parts dark russet-brown, darkest along the middle of the back (but no trace of dorsal band in Louisiana specimens); nose and front of face to above eyes dusky, more or less tinged with russet; sides washed with pale fulvous; belly dark plumbeous, more or less obscured by pale buffy-fulvous tips to the hairs; feet and throat white; hairs on base of tail dusky (remainder of tail practically naked). The color of the back is hard to describe, and the term used ('russet-brown') is intended only as roughly indicating the general effect. The individual hairs are dark plumbeous, with a narrow subapical zone of dark fulvous, tipped with sooty.

Cranial characters.—Skull similar to *G. lutescens* in general appearance but smaller; zygomata broadly spreading; frontal flat, depressed; nasals narrow, emarginate posteriorly, their sides nearly parallel for posterior two-thirds, abruptly divergent anteriorly; ascending branches of premaxilla broad and bluntly rounded posteriorly; interparietal small, very irregular, and much cut up with tortuous windings of the sutures as in true 'Wormian' bones; temporal impressions never uniting in a sagittal crest but permanently distant, the interspace elevated, forming a broad convex band (3 to 5 mm. in width) along the top of the skull posteriorly; jugal longer than basioccipital, bluntly rounded anteriorly; occiput bulging behind lambdoid suture, but not so far as in *texensis*; pterygoids narrow, tapering posteriorly.

Skulls of *breviceps* may be distinguished from those of *lutescens* by the following characters (pl. 9, fig. 6): Size smaller; nasals narrower, shorter, and strongly emarginate posteriorly; ascending branches of premaxilla normally shorter and more bluntly rounded posteriorly; temporal impressions persistent, distant, the bone thickened between them; interparietal 'Wormian'-like; zygomata more rounded; interorbital region more depressed. Nevertheless, the cranial resemblances are striking in view of the dissimilarity of the animals in size and external appearance. Moreover, skulls of *breviceps* from the western part of its range have broader nasals; and skulls of *lutescens* from adjacent territory have a narrow sagittal area (resulting from permanently distant temporal impressions). It is probable, therefore, that the two forms will be found to intergrade.

Skulls of *breviceps* differ from those of *texensis* in larger size, much more spreading zygomata; longer and very much narrower nasals; broader, flatter, and more depressed frontal interorbitally; much longer jugal; smaller and more irregular interparietal; less bulging occiput; broader and more bluntly rounded ends to ascending branches of premaxilla. Viewed in profile, the skull of *breviceps* is flat and somewhat depressed or concave between the orbits; that of *texensis* is normally convex.

Average measurements of 40 specimens of both sexes from type locality (Mer Rouge, Louisiana): Total length, 219; tail vertebræ, 64; hind foot, 27. Average of 15 males from same place: Total length, 231; tail vertebræ, 70; hind foot, 28. Average of 23 females from same place: Total length 212; tail vertebræ, 61; hind foot, 26.5.

For cranial measurements see Table A, p. 205.

General remarks.—The type form of *Geomys breviceps* inhabits northern Louisiana, east of the Red River, the exact type locality being Prairie Mer Rouge in Morehouse Parish, near the northern boundary of the State and only a short distance west of the Mississippi River. The species as a whole is an inhabitant of the dark alluvial soils of the lowlands bordering the Lower Mississippi and its tributaries and the Gulf coast of Texas, whence it spreads westward nearly or quite to the ninety-eighth meridian. To the southward it reaches Nueces Bay. On the west it probably intergrades with *texensis* and *lutescens*. On the north there seems to be a hiatus between its range and that of *bursarius*; but if pocket gophers are ever found in northern Arkansas, southwestern Missouri, southeastern Kansas, or northeastern Indian Territory, they are likely to prove intergrades.

Departures from the type.—Specimens from extreme points in the range of the species differ much from the type. Two of these forms are here named as subspecies (*G. breviceps sagittalis* and *G. breviceps attwateri*). Others are regarded as slightly aberrant forms not meriting recognition by name; others still as intergrades. The following, contained in the Department of Agriculture collection, seem worthy of mention:

(1) A large dark form inhabiting the valley of the Arkansas River. The skulls point toward intergradation with the interior animal. Specimens from Tulsa and Fort Gibson, Indian Territory, and Fort Smith, Arkansas, resemble *breviceps* in coloration, while those from Ponca Agency, Indian Territory, are redder, shading strongly toward *lutescens*.

(2) A form from the valley of the Red River of the South, along the boundary between Texas and Indian Territory (specimens from Gainesville, Tex., and from Indian Territory opposite Arthur, Tex.). A small reddish form resembling *breviceps* externally, but with dark belly and a short tail. The skulls are more like *texensis* in general form (full brain case and narrow zygomata), and in the shortness and breadth of the nasals; but the ascending arms of the premaxilla are even shorter and more bluntly rounded posteriorly than in *breviceps*. The frontal and interparietal are intermediate between the two.* Regarded as an intergrade.

(3) A form from Shreveport, Louisiana. Much redder than true *breviceps*, resembling *texensis* in coloration of upper parts, but with dark belly. The skull differs from typical *breviceps* in more angular zygomata, broader nasals, and less depressed frontal. Regarded as a slight local departure from *breviceps*.

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* Skull No. 47590 ♂ ad. from Gainesville, Texas, is an excellent example of this form.

(4) A form from Galveston Bay, Texas (specimens from Clear Creek and Arcadia). A small, dark, highly-colored form with the head nearly black, and the throat and fore feet usually wholly or partly white, in sharp contrast with the dark of the surrounding parts. The skull differs from that of typical *breviceps* in smaller size, and in having shorter and broader nasals. Regarded as a subspecies and described under the name *sagittalis*. (Pl. 9, fig. 4.)

(5) A form from the coastal plane of Texas (specimens from Brenham, Milano, Hearne, Marquez, and Palestine.) Usually has a well-marked dark dorsal band, and the skulls differ from typical *breviceps* in having shorter and broader nasals. Skulls of old males from these localities are unusually short and have broadly spreading zygomata. The nasals are very broad posteriorly in comparison with true *breviceps*. Regarded as an aberrant form, perhaps shading toward *texensis* on one side and toward *attwateri* and *sagittalis* on the other.

(6) A form from the extreme southern limit of the range of the species on and near the Gulf coast of Texas. (Specimens from Rockport, Aransas County; Tallys Island, Aransas County, and near San Antonio.) A large dark form with a dark dorsal band in some pelages, and peculiar cranial characters: angular and strongly divergent zygomata, very broad ascending arms of premaxilla, and so on. Regarded as a subspecies, and described under the name *attwateri* (pl. 9, fig. 3).

Specimens examined.—Total number, 274, from the following localities:

Typical or nearly typical.—Mer Rouge, Morehouse Parish, Louisiana (type locality), 42; Pineville, Rapides Parish, Louisiana, 2; Provencal, Natchitoches Parish, Louisiana, 4; Shreveport, Caddo Parish, Louisiana, 8; Camden, Ouachita County, Arkansas, 1; Benton, Arkansas, 7; Fort Smith, Arkansas, 7; Fort Gibson, Indian Territory, 16; Tulsa, Indian Territory, 2.

Not typical.—Gainesville, Cook County, Texas, 5; Decatur, Texas, 1; Indian Territory, near mouth of Boggy River (opposite Arthur, Texas), 4; Ponca Agency, Oklahoma, 6; Oklahoma City, Oklahoma, 3. The following, all from Texas: Longview, 4; Mineola, 14; Terrell, 7; Troup, 1; Palestine, 5; Marquez, 5; Hearne, 9; Milano, 12; Brenham, 7; Victoria, 1; Inez, 3; Navidad River, 1; Houston, 9; Matagorda Bay, 9.

Subspecies sagittalis.—Mouth of Clear Creek, Galveston Bay, 4; Arcadia, Galveston Bay, 22.

Subspecies attwateri.—Rockport, Aransas County, 40; Tallys Island, Aransas County, 3; Calaveras, Wilson County, 3; San Antonio (18 miles south), Bexar County, 7.

Mr. Vernon Bailey, chief field naturalist of the Division, visited the type locality of *Geomys breviceps*, Prairie Mer Rouge, Morehouse Parish, Louisiana, in June, 1892, for the purpose of obtaining a series of duplicate types of the species. He found it common throughout the fields of the open country and along roads and fields in the woods of the flat land, except where flooded, but not in standing timber or on hilly land. He states: "They do not seem to be so common in cultivated land as in pastures and along fences and roadways. In one pasture of 20 acres we caught fifteen and one remained. They were more abundant at this point than elsewhere—probably twice as numerous to the area as they would average over the whole prairie. The damage done in the pasture by covering grass was trifling. This species does not seem to dig extensively, and the hills are small. Usually one or two are thrown up in a night. In one place, where a gopher had run his tunnel in a straight course, I counted sixteen hills in a line 6 rods long (measured). A hill of average size measured 24 by 15 inches in diameter and 5 inches in height. Probably the reason the gophers do not dig more extensively is that food is abundant and the soil compact. The greatest damage the farmers claim from gophers, or 'salamanders' as they are called here, is that they carry the tubers of the troublesome cocoa or nut grass from place to place, often bringing them from a roadside or waste place and storing a large quantity in their burrows in gardens or fields and leaving them to grow where they had been kept out with great difficulty. This cocoa grass is one of the worst plants with which the farmers are troubled and is very difficult to get rid of when once started in the land. Small tubers are borne along the roots, and these are carried by the gophers, though I have not found them in their pockets. The stomachs examined contained green vegetable matter. White clover seems to be a favorite food. Most of the specimens taken were moderately fat. In June the young were half grown to nearly full grown. Of 27 specimens which I examined, 12 were males and 15 females."*

Mr. C. L. Newman writes me that at Camden, Arkansas, this species (specimen received for identification) is abundant in sections of the Ouachita River Valley, where they are known almost exclusively as 'salamanders.' He says: "They seem to prefer old fields that have grown up in pine. I know of a place about a mile from Camden where the surface of about an acre of ground is mulched with loose earth brought from their burrows. Last year (1893) I caught twenty-three from about 6 acres of ground."

* Mr. Vernon Bailey contributes the following notes on a specimen examined in the flesh at Mer Rouge, La., in June, 1892: "Size small; pelage very soft and silky; skin loose, as though much too large for the body; body soft and flabby; soles of feet, nose, and end of tail hairless, smooth, shining, and white when clean. Lips hairy over the edges, but roof of mouth not hairy all the way across, a narrow line of smooth skin extending along the median line to the incisors; eyes small for a *Geomys*; cornea relatively large, measuring 3 mm. across, nearly equaling diameter of ball; no apparent lid, eye opening 3.5 mm. by 2 mm. (normally), its long axis parallel to a line drawn from ear to tip of nose; color of eye appearing shiny black; ears consist of a circular rim 1 mm. high and about 5 mm. in diameter; opening of meatus 2 by 2.5 mm., slightly elongated vertically; mustache spreading forward and back; distance from eye to end of nose 21 mm.; from eye to center of ear, 17 mm."

GEOMYS BREVICEPS SAGITTALIS subsp. nov.

(Pl. 9, fig. 4.)

Type from Clear Creek, Galveston Bay, Texas. No. $\frac{32239}{44937}$ ♂ ad. U. S. Nat. Museum, Department of Agriculture collection. Collected March 28, 1892, by William Lloyd. (Original number 1181.)

Geographic distribution.—Gulf coast of Texas about Galveston Bay.

General characters.—Similar to *breviceps*, but smaller and more highly colored; head very dark; throat and fore feet pure white in sharp contrast to dark of surrounding parts. The skull differs in having a distinct sagittal crest and in other particulars.

Color.—Upper parts rich, glossy, russet brown, strongly tinged with fulvous, becoming dusky along the middle of the back and head (but no distinct dorsal band); entire head and nose very dark, almost black, but washed in places with fulvous; inside of cheek pouches, chin, throat (breast also in some specimens), and fore legs pure white in sharp contrast. On the upper side of the fore legs the dark color of the sides reaches down about half way to the wrists and ends abruptly with a sharp line of demarkation. The under side of the fore legs is pure white to elbow. The belly varies from whitish, strongly washed with buffy ochraceous, to fulvous. The Arcadia specimens are not exactly like those from the mouth of Clear Creek.

Cranial characters (type specimen).—Skull similar to that of *breviceps* but smaller; zygomata more divergent anteriorly (in male); nasals shorter and broader posteriorly, bringing the constriction much nearer the middle; audital bullæ smaller; ascending branches of premaxillæ narrower posteriorly; temporal impressions meeting in a well marked sagittal crest in male. In the female the temporal impressions never meet in a sagittal crest; the brain case is smoothly rounded, and the interparietal persists as a relatively large bone.

In the Arcadia males the temporal impressions do not meet in a sagittal crest as in the type.

Measurements (taken in flesh).—*Type:* Total length, 225; tail vertebræ, 70; hind foot, 27.

Average (of 5 males from Arcadia, Galveston County): Total length, 220; tail vertebræ, 64; hind foot, 26.

Average (of 15 females from same place): Total length, 196; tail vertebræ, 54; hind foot, 23.

For cranial measurements, see Table A, p. 205.

Specimens examined.—Total number 24: 4 from Clear Creek, Galveston Bay, and 20 from Arcadia, Galveston County, Texas.

General remarks.—To the northwestward *sagittalis* passes into the coastal plain form already mentioned under the head of *G. breviceps*. Old males of this form sometimes develop remarkably broad skulls. The broadest skull that I have seen in the restricted genus *Geomys* is an old male from Brenham, Washington County, Texas (No. 63612). It affords the following measurements and ratios: Basal length, 40;

basilar length of Hensel, 37; zygomatic breadth, [illegible]. Ratio of zygomatic breadth to basal length, 71; to basilar length of Hensel, 77.

GEOMYS BREVICEPS ATTWATERI * subsp. nov.

Pl. [illegible], fig. 3.

Type from ROCKPORT, ARANSAS COUNTY, TEXAS. No. [illegible] ♂ ad., U. S. Nat. Museum, Department of Agriculture collection. Collected November [illegible], by E. E. Keays. (Original No. 36.)

Geographic distribution.—Coastal plain and islands of Texas between Matagorda and Nueces bays; penetrates the interior to within a few miles of San Antonio. The south side of Nueces Bay is the home of another form (*G. personatus fallax*).

General characters.—Similar to *G. breviceps*, but larger and less dark in color; feet and basal third to half of tail moderately well haired for a *Geomys*; terminal half to two-thirds of tail nearly naked; zygomatic arches angular, strongly divergent anteriorly.

Color.—Upper parts russet brown, becoming dusky on the head and usually along the median part of the back; under parts varying from soiled whitish to buffy ochraceous. In some specimens the color of the upper parts is less fulvous than in others, and the dark dorsal band is variable; in some specimens it is absent, sometimes the head is nearly black from end of nose to occiput, the blackish area limited laterally by the eyes and ears, the sides of the face being russet in rather strong contrast. The type specimen is in this pelage except on the hinder part of the back and rump where the more fulvous summer pelage remains, without trace of the dorsal band.

Cranial characters.—Skull similar to that of *breviceps*, but frontal less depressed interorbitally; zygomata less spread but strongly divergent anteriorly, more angular, more depressed, the maxillary arm sloping strongly backward; ascending branches of premaxillæ broader and usually more abruptly truncate posteriorly; nasals shorter and commonly convex instead of emarginate posteriorly. The nasals are [illegible] narrow posteriorly, and the premaxillæ so broad that [illegible] the latter nearly meet behind the former as in the type specimen (pl. [illegible], fig. 3). Normal skulls of *attwateri* differ markedly from those of *breviceps* in the form of the zygomata, the maxillary arms sloping strongly backward instead of standing out at right angles, and the zygomata being strongly divergent instead of nearly parallel. The nasals are narrower and contracted posteriorly, the ascending arms of the premaxillæ broader, and the audital bullæ less swollen. In the series of [illegible] skulls of *Geomys breviceps attwateri* now before me, [illegible] depart from the normal in general outline, as seen from above, [illegible] in the form of the anterior part of the zygomata, which stand out squarely from the cranial axis and have the anterior external angles

* Named in honor of Mr. H. P. Attwater, of San Antonio, Texas, who collected nearly all of the specimens.

broadly rounded. In other respects they are typical *attwateri*. All are very old males, collected at Rockport by Mr. Attwater (original Nos. 102, 118 and 119). They now belong to the American Museum of Natural History in New York.

Measurements (taken in flesh).—*Type:* Total length, 250; tail vertebræ, 85; hind foot, 30.5.

Average of 10 males from type locality: Total length, 255; tail vertebræ, 80; hind foot, 30.

Average of 7 females from type locality: Total length, 220; tail vertebræ, 68; hind foot, 28.

For cranial measurements see Table A, p. 205.

Specimens examined.—Total number 53, from the following localities on or near the Gulf coast of Texas: Rockport, Aransas County (type locality), 40; Tallys Island, Aransas County, 3; Calaveras, Wilson County, 3; San Antonio (18 miles south), Bexar County, 7.

General remarks.—*Geomys breviceps attwateri* is a medium-sized species closely resembling its near neighbor *G. fallax* in color, though somewhat darker, and with the hind foot shorter. The resemblance to *G. breviceps* is much closer in the plumbeous russet pelage than in the fulvous pelage.

Mr. H. P. Attwater has kindly contributed the following memorandum respecting the habits of this gopher at Rockport, Texas: "As soon as the warm weather sets in, from about May to September, very few gophers are observed working. The soil is sandy, and at all times damp, dampness known as 'natural subirrigation.' In the hot weather the dampness does not come as near the surface as in the cooler months. I have thought that perhaps the gophers travel deeper in summer, but now think the chief reason why they do not throw up hills in summer, as they do in fall and winter, is that during the summer months the soil is so full of roots, suckers, bulbs, etc., that they do not have far to go before finding all they can eat, and that the reason they work so much after the summer months are over is because they are hunting around to find some bulb or root which was their favorite food in summer, and which they commenced to find about the month of May, and was over with in September. The animals are very abundant all over the peninsulas in Aransas County, wherever the soil is sandy. There is hardly a foot of land that has not been 'plowed' several times over by gophers, and I believe the fertility of some sections has been greatly improved by them, by bringing the poorer soil up to the top. I have noticed that the richer the land the richer the gophers. Of course they do considerable damage to vegetable crops, especially to young fruit trees and cuttings just rooting. The samples sent you of mulberry trees cut by gophers were from the Faulkners' ranch, on St. Charles peninsula, in the eastern part of the county. Mr. Samuel Walker, the manager of the ranch, told me that he killed over two hundred and fifty gophers in his young pear orchard between the 1st of

March and April 15, 1893. This orchard was set out where sweet potatoes had grown the year before, and they came up again and covered the ground, and I think the potatoes attracted the gophers in the first place more than the pear trees."

GEOMYS TEXENSIS sp. nov.

(Pl. 9, fig. 2; pl. 13, fig. 12.)

Type from MASON, MASON COUNTY, TEXAS. No. $\frac{1999}{2349}$ ♀ ad. Merriam collection. Collected by Rev. Ira B. Henry, December 17, 1885.

Geographic distribution.—Mason County, central Texas, and probably thence southerly to the Rio Grande; limits of range unknown (map 4, E).

General characters.—One of the smallest known species; tail short; terminal third nearly naked.

Color.—Upper parts liver-brown, finely mixed with black-tipped hairs, much as in *G. bursarius.* Under parts and feet white. The hairs of the belly are plumbeous at base in the type and other winter specimens; in summer specimens they are white throughout. Throat suffused with pale buffy fulvous, forming a complete collar. In some specimens this collar is interrupted along the median line. The color of the upper parts is darker in winter than in summer, as usual in the genus. There is no trace of a dark dorsal band in adults, but in the young the black-tipped hairs are sometimes concentrated along the middle of the back, forming an ill defined dark streak.

Cranial characters.—Skull small (smallest of the known species), smooth; zygomata only moderately spreading and normally but slightly divergent anteriorly; nasals short, rather broad and convex or truncate behind; ascending branches of premaxilla long, normally passing plane of lacrymals, usually straight on inner edge behind nasals and attenuate on outer edge; temporal impressions not forming distinct ridges and not uniting in a sagittal crest, usually separated by interspace 1–3 mm. broad in adults; jugal short (shorter than basioccipital); interparietal broader than long, normally oval or elliptical and projecting posteriorly behind plane of lambdoid suture; occiput bulging posteriorly more than in any other United States species (resembling *Pappogeomys bulleri* and some species of *Thomomys*).

Skulls of *texensis* differ conspicuously from those of *G. arenarius* in the following points: Nasal branches of premaxilla longer and more pointed posteriorly; jugal more slender; no distinct knob at end of squamosal arm of zygoma; no distinct temporal ridges; interparietal projecting posteriorly behind plane of lambdoid suture; occiput more bulging posteriorly; mandible less heavy. *G. texensis* differs from *G. breviceps* in the shape of the nasal bones which are usually short, very broad posteriorly, with the sides nearly parallel. In *G. breviceps* they are usually longer, strongly wedge shaped, very narrow posteriorly, with the anterior third abruptly broader and flaring. In *texensis* the nasal branches of the premaxilla reach or pass the plane of the orbital fossa and are pointed; in *breviceps* they usually fall short of this plane and are bluntly rounded. In *texensis* the jugal is shorter than the *basioccipital*; in *breviceps* it is longer. In *breviceps* the outer angle of the zygomatic arch is evenly rounded; in *texensis* it is angular and abruptly flattened (or even excavated) on its infero-external face, beginning at the angle and extending posteriorly under the jugal (as seen from the side). The inflated mastoids and audital bullæ are larger in *breviceps*, in which species the mastoids are conspicuously broader than in *texensis*, the exposed part, viewed from behind, being as broad as high, while in *texensis* the breadth is only about half the height. But the range of individual variation is so great that much confidence can not be placed on this character.* In *breviceps* the frontal is flatter and depressed interorbitally, forming a slight concavity in the plane of the upper side of the skull when seen in profile; in *texensis* the profile is convex at this point.

Skulls of *Geomys texensis* differ from those of *G. bursarius*, in addition to their much smaller size, in shorter rostrum and brain case, less prominent ridges and processes for muscular attachments, absence of sagittal and lambdoidal crests at all ages; much larger interparietal; much larger audital bullæ (which are inflated and rounded antero-laterally instead of flattened), and in the greater length of the ascending branches of the premaxilla posteriorly. The skull as a whole is not only much smaller than that of *bursarius*, but is relatively thin and smooth, like that of *Thomomys*. The arch of the brain case is low, but not so flat as in *breviceps*, and the temporal impressions never meet along the median line.

Measurements.—Type specimen: Total length, 203 (measured in flesh); hind foot, 28 (in dry skin moistened to straighten the toes). Tail not measured in flesh, but short; about 60 in dry skin. Average total length of 28 specimens from type locality measured in flesh, 210.

For cranial measurements see Table B, p. 206.

Specimens examined.—Total number 31, from the following localities in Texas: Mason, Mason County (type locality), 28; Laredo, 1; Sycamore Tree (on Rio Grande), 1; Del Rio (on Rio Grande), 1.

General remarks.—*Geomys texensis* is a small white-bellied species inhabiting central Texas. Its back is chestnut-brown or liver-brown, much as in the large dark-bellied *G. bursarius*, with which it requires no comparison. It is the smallest species in the United States, about equaling *Pappogeomys bulleri* of Mexico. The only bisulcate species of approximately the same size are *G. breviceps* of Louisiana and its subspecies *sagittalis* of the Gulf coast of Texas, and *G. arenarius* of the Upper Rio Grande Valley in extreme western Texas and south-cen-

* The actual size of the mastoid is often hidden by the thin outer edge of the exoccipital which overlies its inner border, and which is not always alike on the two sides. Hence it sometimes happens that the exposed part of the mastoid is narrow on one side and broad on the other.

tral New Mexico, with all of which it may intergrade, although it differs widely from them all in color and cranial characters, as elsewhere shown. On the north, in Oklahoma and southern Kansas, it probably intergrades with *G. lutescens*.

Three specimens of a small *Geomys* from as many points in the Rio Grande Valley (Laredo, Del Rio, and Sycamore Creek) are provisionally referred to the present species. The Laredo specimen lacks the skull and its upper parts are more drab than usual. The specimens from Del Rio and the mouth of Sycamore Creek are too immature for positive identification. They differ from the young of *texensis* from the type locality in having longer tails, somewhat darker backs, and in lacking the chestnut tint on the sides. Their skulls seem to be intermediate between *texensis* and *arenarius*. Mr. William Lloyd, who collected the Sycamore Creek specimen, states that the species is rare there and was found only in a belt of fine sand along the Rio Grande. He found a species, presumably the same, on chalky soil near Comstock. Mr. Vernon Bailey collected the Del Rio specimen in the river bottom, where the species was rather rare.

GEOMYS ARENARIUS sp. nov.

(Pl. 9, fig. 1; pl. 13, fig. 13.)

Type from EL PASO, TEXAS. No. [illegible] ♂ ad. U. S. National Museum, Department of Agriculture collection. Collected December 13, 1889, by Vernon Bailey (Original No. 798).

Geographic distribution.—Valley of the Upper Rio Grande, from El Paso, in extreme western Texas, and Juarez, Chihuahua (on the Mexican side of the river opposite El Paso), north to Las Cruces, New Mexico, and west to Deming, in the same state (map 4, G). It will probably be found to follow the valley somewhat further in both directions, and to the east may intergrade with *texensis*. So far as now known its range seems to be separated by a broad interval from that of the species inhabiting central and southern Texas, the westernmost records of which are Del Rio and Comstock, in the Rio Grande Valley. Curiously enough the intervening region is inhabited by a widely different Pocket Gopher, one belonging to the unisulcate series, namely, *Cratogeomys castanops*. The ranges of all the other bisulcate species, except *tuza*, are either directly continuous or contiguous. In faunal position *G. arenarius* belongs to the upper edge of the Lower Sonoran Zone.

General characters.—Size medium; tail rather long and unusually well haired, except near tip; coloration pale.

Color.—Upper parts drab-brown, finely mixed with black-tipped hairs; under parts and feet white. In some specimens the color of the sides encroaches on the belly and is only partly masked by the white tips of the hairs.

Cranial characters.—Skull resembling *Thomomys talpoides;* size rather small (intermediate between *texensis* and *breviceps*); zygomata normally narrow and nearly parallel (in one ♂ from El Paso, No. 58340, they are exceptionally divergent anteriorly); no sagittal crest at any age; temporal ridges prominent, distant, and nearly parallel or slightly divergent anteriorly, usually separated by a flat or concave interspace 4 to 5 mm wide, as in *Thomomys talpoides;* squamosal arm of zygoma ending in a prominent knob over middle of jugal (diagnostic of the species); jugal short (shorter than basioccipital); interparietal rather large, normally (but not always) broader than long, usually subquadrangular or with the corners rounded anteriorly, truncate posteriorly on plane of lambdoid suture; occiput bulging posteriorly, but not so far as in *texensis;* palatopterygoids normally abruptly narrow, their sides nearly parallel (but form somewhat variable); mandible heavy for size of skull. The females differ from the males in having shorter nasals, larger parietals, and less prominent temporal ridges. As a rule the interspace is somewhat thickened and the ridge is evident from the outer side only.

The skull of *G. arenarius* differs from that of *texensis* in the following characters: Jugal heavier and broader; temporal ridges much more prominent and distant; a prominent knob at distal end of squamosal arm of zygoma; top of skull flatter; frontal broader and flatter interorbitally; interparietal truncate posteriorly on plane of lambdoid suture; occiput less bulging. It differs from *lutescens* in much smaller size, narrower and more parallel zygomata; shorter jugal; in the presence of well-developed distant temporal ridges, and of a prominent knob at distal end of squamosal arm of zygoma; shorter and somewhat narrower nasals, and shorter ends of ascending arms of premaxilla behind the nasals.

Measurements (taken in flesh).—Type specimen (♂ ad.): Total length 258; tail vertebræ, 88; hind foot, 33. Average of 8 males from type locality: Total length, 260; tail vertebræ, 83; hind foot, 32. Average of 24 females* from type locality: Total length, 250; tail vertebræ, 78; hind foot, 32.

For cranial measurements see Table B, p. 207.

Specimens examined.—Total number 43, from the following localities: Juarez, Mexico, 3; El Paso, Texas, 30; Deming, New Mexico, 3; Las Cruces New Mexico, 7.

General remarks.—In color and external appearance *Geomys arenarius* closely resembles the typical form of *G. lutescens* (from western Nebraska and eastern Wyoming), differing chiefly in smaller size and in greater length and hairiness of tail. From its nearest ally in central Texas (*G. texensis*) it differs both in color and proportions, having the upper parts pale drab instead of reddish brown, and the tail long and hairy instead of short and nearly naked. In cranial characters it may be distinguished from all other species by the presence of distant tem-

*Some of the specimens recorded as females are very large and were probably males; hence the averages here given for females are probably too great.

poral ridges or ribs, which are nearly parallel, in connection with the development of a prominent knob at the distal end of the squamosal arm of the zygoma.

This fine species was discovered by my assistant, Mr. Vernon Bailey, at El Paso, Texas, in December, 1889, and was obtained by him at Deming, New Mexico, also. Mr. J. Alden Loring, who was sent to the Upper Rio Grande Valley to work out its range, secured a large series from Las Cruces, New Mexico, and Juarez, Chihuahua, Mexico, as well as at the type locality, El Paso, Texas. Mr. Loring says: "They are not very common on the Mexican side of the river, but extremely so on American soil, where they seem to thrive and grow fat. The places they most prefer are railroad embankments and irrigation ditches, where they were found both in sand and wet, dark clayey soil. Two were seen on February 5 just as they protruded their heads from their holes. Their faces were covered with dirt, and as soon as they had shaken it off they saw me and quickly dodged back. When these Gophers were caught I noticed that they walked with the claws of the front feet partially doubled under, which did not allow the sole of the foot to touch the ground."

GEOMYS PERSONATUS True.

(Pl. 12, fig. 4; pl. 13, fig. 14; pl. 14, fig. 4.)

Geomys personatus True, Proc. U. S. National Museum, XI (for 1888), Jan. 5, 1889, 159-160.

Type locality.—PADRE ISLAND, TEXAS.

Geographic distribution.—The Tamaulipan fauna of Texas, comprising Padre Island and the adjacent mainland southwesterly to Carrizo on the Rio Grande (map 4, F).

General characters.—Size large; coloration pale; tail long, scant-haired on proximal half and nearly naked on distal half.

Color.—Upper parts pale drab (darker in winter from more liberal admixture of dark-tipped hairs); middle of face from nose to above eyes inclining to dusky. Under parts white, sometimes obscurely clouded, from the presence of irregular patches of hairs with plumbeous bases, the hairs on other parts of the belly white to roots. Tail hairs white, but too far apart to give color to the nearly naked tail.

Cranial characters.—Skull large, heavy, with well-developed processes and ridges and a high sagittal crest (pl. 12, fig. 4); zygomata standing out at right angle to axis of skull; jugal bluntly and broadly rounded anteriorly, and short, not longer than basioccipital (measured from condyle); nasals long and narrow, anterior third spreading; frontal narrow interorbitally, the orbital borders rounded; basioccipital with sides parallel, or nearly parallel. In profile the top of the skull (including the sagittal crest) is nearly a straight line.

Adult skulls of *Geomys personatus* may be easily distinguished from those of *bursarius* and *lutescens* by the squareness of the zygomatic arches anteriorly, the shortness of the jugal bone anteriorly, with corresponding production of the maxillary arm of the zygoma. The greatest length of the jugal in *personatus* is only equal to the length of the basioccipital bone (measured from the condyle). In both *bursarius* and *lutescens* the jugal is much longer than the basioccipital. In *personatus* the skull as a whole is relatively as well as actually longer, and narrower across the zygomatic arches, than that of *lutescens*, from which it differs further in the following particulars: zygomatic breadth usually less than distance from foramen magnum to incisive foramina (the contrary being usually true in *lutescens*); ascending branches of premaxilla extending much further posteriorly; zygomatic arches relatively long, only moderately spreading anteriorly (except in extreme age), but standing out at right angle to longitudinal axis of skull; orbital fossæ elongated antero-posteriorly instead of subtriangular; length of frontal along median line usually equal to length of nasals (commonly shorter in *lutescens*); audital bullæ longer, with outer side flattened; inflated mastoid smaller. Skulls of *personatus* average longer in proportion to the zygomatic breadth than those of any other known bisulcate species, except the Mexican *Zygogeomys trichopus* (the ratio of zygomatic breadth to basilar length ranging from 68 to 72 percent), though in this respect they differ but slightly from *Geomys bursarius*.

Measurements.—Of 13 specimens (of both sexes) from type locality (Padre Island): Total length, 399; tail vertebræ, 103; hind foot, 37. Average of 4 males: Total length, 315; tail vertebræ, 111; hind foot, 40. Average of 9 females: Total length, 293; tail vertebræ 100; hind foot, 36.

For cranial measurements see Table B, p. 206.

Specimens examined.—Total number 33, from the following localities on or near the Gulf coast of Texas: Padre Island (type locality), 15; near Santa Rosa, 8; Sauz Rancho, 6; Carrizo, 3.

Number of subspecies *fallax* 22, as follows: Nueces Bay and River (south side), 6; Corpus Christi, 15; Las Mottes, 1.

Departures from the type.—The type locality of *Geomys personatus* is Padre Island. Fairly typical specimens are at hand from points on the mainland west of the southern part of this island, namely, Santa Rosa and the Arroyo Colorado (Sauz Rancho), and also from Carrizo on the Rio Grande, though the latter depart somewhat from the type. Singularly enough, specimens from the lower Nueces River and Bay, and from Corpus Christi and Las Mottes, differ decidedly from the typical animal in smaller size, darker color, and in important cranial characters. The skull is much smaller, more abruptly truncate posteriorly, with more spreading zygomatic arches, and much more globular audital bullæ (pl. 12, fig. 3). This form is here separated sub-specifically under the name *Geomys personatus fallax* (see p. 144). Intergradation between *personatus* and *fallax* probably occurs in the narrow strip between Santa

Rosa and Corpus Christi Bay, since the single specimen from Las Mottes, a few miles south of Nueces Bay, is somewhat larger than the Nueces Bay and Corpus Christi specimens.

Some of the specimens from Santa Rosa are fairly typical *personatus*, though all have more swollen audital and mastoid bullæ. One adult skull (No. 42,860) from the Arroyo Colorado (Sauz Rancho, about 50 miles north of Brownsville) has a very narrow rostrum, narrow zygomata, projecting occiput, very much swollen mastoid and audital bullæ (the latter almost subglobular) and abnormally short and narrow jugal. Five other skulls from the same locality are young and apparently less extreme. The adult skull may be regarded as abnormal, or as pointing to the differentiation of an incipient race.

General remarks.—*Geomys personatus* resembles *G. lutescens* in summer pelage more closely than any other form. The typical animal may be distinguished from *lutescens* at all seasons by larger size, longer feet and tail, by important cranial characters (just described in detail), and by the white of the under parts. In summer specimens of *G. lutescens* the belly is sometimes pale, but rarely white except in the very young. The color of the upper parts in summer pelage differs but little in the two species, being drab in both, with the nose and middle of the face, as far back as the eyes, inclining to dusky; but in winter and early spring the two differ notably, the dusky face markings of *lutescens* extending posteriorly over the head and back to the rump, forming a distinct dorsal stripe. In this pelage, also, the under parts are much darker, the fur being dark plumbeous, tipped with drab. While *personatus* is the larger of the two animals, the claws of the fore feet are equally large (and relatively larger) in *lutescens*. In some specimens of *personatus* the claws are remarkably long and slender—the result, doubtless, of the unresisting character of the sand in which the animals live.

The geographic distribution of *Geomys personatus* (including subspecies *fallax*) appears to coincide with the limits of the arid tropical area of Texas—an area recognized and defined by me in 1892,* and subsequently named the *Tamaulipan fauna* by Allen.† The range of the species has been ascertained to terminate abruptly both on the north and on the west, specimens from a few miles north of Corpus Christi Bay, and from Laredo on the Rio Grande, belonging to different species.

Mr. William Lloyd, who collected the specimens, states that *G. personatus* is abundant in a patch of fine sandy soil above Carrizo, but was not found elsewhere in the neighborhood. He states further that in traveling north from the mouth of the Rio Grande it was first met on entering the great sand belt on the north side of the Arroyo Colorado (at El Sauz). It continued throughout this sand belt, becoming more abundant to the northward. On Padre Island he found the animals living in colonies, perhaps a mile or more apart, and common from the

* Presidential Address, Proc. Biol. Soc., Washington, April, 1892, p. 33.
† Bull. Am. Museum Nat. Hist., New York, Vol. IV, Jan., 1893, 241-242.

north end to the center of the island, but not within 20 miles of the south end. Mr. Lloyd says: "Their habits are in some respects peculiar, owing perhaps to the soft sand that caves in on them, or to fear of the coyotes, or for both reasons; they fill up their tunnels for a yard or two almost immediately after they throw out the dirt. They can not go very deep in the flats or they would reach water; in fact, the water filled some of the tunnels for about a foot until they curved upward. Not more than one is ever found in a hole."

GEOMYS PERSONATUS FALLAX subsp. nov.

(Pl. 12 fig. 3.)

Type from south side of NUECES BAY, TEXAS. No. $\frac{32021}{44843}$ ♂ ad. Collected November 30, 1891, by William Lloyd. (Original No. 949.)

Geographic distribution.—South shore of Nueces Bay and lower Nueces River, Texas; further south passing into *G. personatus.*

General characters.—Similar in external appearance to *G. personatus* of Padre Island, but much smaller (only about half the bulk of that species); somewhat darker; tail shorter and nearly naked.

Color.—Upper parts drab-brown, darker in winter; paler and more fulvous in summer; nose and face between eyes dusky; sometimes an ill-defined dusky band along the middle of the back. Under parts usually marbled with pure white and patches of dark hair (the white hair being white to roots).

Cranial characters.—Skull similar to that of *personatus*, but very much smaller (pl. 12, fig. 3). The zygomata stand out squarely at right angles to axis of cranium and are widely spreading, their outer sides nearly parallel; the temporal impressions meet in the males in a well-marked sagittal crest; in the females they remain apart, separated by an interspace about 3 millimeters wide; nasals rather broad and blunt posteriorly; jugals short (not longer than basioccipital); mastoid and audital bullæ swollen, the latter short and rounded; palatopterygoids narrow, their sides nearly parallel. Skulls of *fallax* differ from those of *personatus* in very much smaller size, shorter (and usually blunter) ascending arms of premaxilla, more squarely truncate occiput (lambdoid crest less convex posteriorly), and in much shorter and more swollen audital bullæ.

Geomys personatus fallax differs markedly from *G. attwateri* (which it approaches in size) in the form of the zygomata, the maxillary arm standing out at right angle instead of sloping strongly backward, and the outer sides of the arches being nearly parallel instead of strongly divergent anteriorly. It differs further in having more globular audital bullæ, broader nasals, narrower ascending branches of the premaxilla, and in the males a well-developed sagittal crest instead of permanent temporal ridges.

Measurements.—Type specimen: Total length, 250; tail vertebræ, 80; hind foot, 35. Average of 9 males from south side of Nueces Bay: Total length, 263; tail vertebræ, 87; hind foot, 34. Average of 10 females from same locality: Total length, 236; tail vertebræ, 75; hind foot, 31.

For cranial measurements see Table B, p. 206.

Specimens examined.—Total number 32, from the following localities on or near Nueces Bay, Texas: Nueces Bay, 4; Nueces River, 10 miles from mouth, 2; Corpus Christi 15; Las Mottes, 1.

General remarks.—*Geomys fallax* is a miniature of *G. personatus*, both in external appearance and in the general form of the skull. It is hardly more than half the bulk and weight of *personatus*, from which it differs further in somewhat darker coloration and in cranial details. The geographic range of the typical form is remarkably restricted, being limited, so far as known, to the south side of the lower Nueces River and Bay.

In his notes on mammals observed in southeastern Texas, Mr. William Lloyd states that this species "is abundant in all soils, although it prefers the black loam. On Nueces Bay they burrow in the sand close to the water's edge, but are most at home on the highest point attainable. I have seen an unbroken line of hills extending from 70 to 100 yards across patches of early pease and onions. They cause havoc among the sweet potatoes, coming above ground to eat them in the daytime. I shot a marsh hawk that was flying off with a gopher which had been thus engaged. While driving along the road cats may be seen frequently a mile from the house intently watching the gophers' holes. The gophers are known to be great pests to fruit and other trees; in more than a dozen instances near the bay I have seen the huisachi (*Acacia farnesiana*) leveled by their work in chewing the rootlets and digging the earth away from the roots."

Genus PAPPOGEOMYS * nob.

(Pl. 11, fig. 1; and text figs. 56, 57 and 58.)

Type *Geomys bulleri* Thomas, from TALPA, MASCOTA, JALISCO.

Dental characters.—Upper premolar with three enamel plates, the posterior absent; m^1 and m^2 with two enamel plates each, as in *Geomys*. Last upper molar an imperfectly double prism; a single sulcus on outer side, behind which the crown is narrowed, forming a moderately well-defined heel; outer enamel plate bent slightly outward near its anterior end. Upper incisor unisulcate, the sulcus median and deep (no trace of minor sulcus; see fig. 21^4).

Cranial characters.—Skull small, short, rather smoothly rounded; a broad sagittal area (no sagittal crest at any age, pl. 11, fig. 1); zygomata slender, rather broadly and squarely spreading, without trace of angular expansion; occiput bulging posteriorly; palatopterygoids little

* *Pappogeomys*, from πάππος, grandfather, + *Geomys*, in reference to the apparent antiquity of the type.

more than vertical lamellæ, slightly everted inferiorly; orbital plates of frontal separated inferiorly by full breadth of cribriform plate as in *Thomomys;* orbitosphenoids broad, articulating firmly with alisphenoids and sending a tongue upward to nearly fill the upper part of the sphenoidal fissure; mesethmoid a nearly vertical plate much higher than long, its inferior edge dipping down between wings of vomer posteriorly; endoturbinals as in *Platygeomys*, the first sharply triangular and the os planum trimmed closely in front of the others.

FIG. 56.—*Pappogeomys bulleri.* Vault of cranium sawed off, showing floor of brain case. (For key see fig. 9).

FIG. 57.—*Pappogeomys bulleri.* Vertical longitudinal section of skull, mesethmoid and vomer in place. (For key see fig. 7).

FIG. 58.—*Pappogeomys bulleri.* Mesethmoid and vomer removed to show endoturbinals. (For key see fig. 10).

External characters.—Size small; pelage soft; form *Thomomine.*

General remarks.—*Pappogeomys* holds an interesting position with reference to the trunk line of the *Geomyidæ.* In dental characters it combines the molariform enamel pattern of *Geomys* with the unisulcate incisors of *Cratogeomys* and *Platygeomys;* and in cranial characters it exhibits striking resemblances to both *Geomys* and *Thomomys* on the one hand, and to *Cratogeomys* on the other. The endoturbinals are not widely different from the *Geomys* type, while the orbitosphenoids depart entirely from *Geomys* and surpass *Cratogeomys* in the extent of their development and articulations. They cut off and shorten the sphenoid fossæ, which in *Geomys* reach forward to the orbital plates of the frontal (pl. 17, fig. 3). The shape of the mesethmoid plate is unique. The form of the skull as a whole is very like the simpler forms of *Thomomys* and *Geomys*—as *texensis* and *arenarius*—and the permanently distant orbital plates of the frontal is a decidedly Thomomine character.

The resemblances to *Geomys* and *Thomomys* do not indicate that *Pappogeomys* has descended from either of these genera, but that it occupies a place near the trunk line and below the point from which they branched off. On the other hand, the resemblances to *Cratogeomys* and *Platygeomys* are prophetic, indicating a position near the base of the great branch that afterward gave rise to these more specialized types.

KEY TO SPECIES OF PAPPOGEOMYS.

Mastoids small, truncate above .... *bulleri*.
Mastoids large, rounded above .... *albinasus*.

PAPPOGEOMYS BULLERI (Thomas).

(Pl. 11, fig. 1; pl. 13, fig. 15; pl. 14, fig. 11.)

Geomys bulleri Thomas, Annals and Magazine Nat. Hist., 6 series, Vol. x, August, 1892, p. 196.
Geomys nelsoni Merriam, Proc. Biol. Soc., Washington, VII, September 29, 1892, 164–165.

Type locality.—Near TALPA, WEST SLOPE OF SIERRA DE MASCOTA, JALISCO, MEXICO (altitude, 8,500 feet). Type in British Museum.

Geographic distribution.—Lower slopes of Sierra Nevada de Colima and Sierra de Mascota, Jalisco, Mexico (map 3[1]).

*General characters.**—Size smallest of the known unisulcate species, of which it is a generalized type; skull small and smooth, resembling *Thomomys;* tail naked; a naked pad on end of nose, partly inclosed in a pale patch.

Color.—Upper parts rich rusty chestnut; underparts paler. An immature but full-grown specimen (No. 33585) is dusky in color, and one in the molt has the anterior parts chestnut and the posterior dusky.

Cranial characters.—The skull of *Pappogeomys bulleri* is small and smoothly rounded, with broadly distant and rather feeble temporal ridges. The maxillary arms of the zygomata stand out at right angles

* The following description is based wholly on specimens from the north slope of the Sierra Nevada de Jalisco. They are larger than Thomas's type and only specimen of *G. bulleri*, and may prove subspecifically separable, in which case the name *nelsoni* will be available.

to the axis of the skull; the zygomata are slender, rather widely spreading, without trace of expanded angle, and their outer sides are nearly parallel (sometimes broader posteriorly than anteriorly). The occiput bulges far behind the lambdoid suture and is smoothly rounded (except in old males, in which it is less inflated and is marked by a median vertical ridge). In all of these respects it agrees with the closely related *P. albinasus* and differs from all other known Mexican species. The frontal is broad and rather flat interorbitally; the nasals narrow and truncate posteriorly; the ascending branches of the premaxilla short, bluntly rounded posteriorly, and barely reaching plane of orbits. The pterygoids are parallel lamellæ, their inferior edges slightly everted—a transition step in the development of the horizontal shelf of *Cratogeomys* from the simple lamella of *Thomomys*. The hamular processes articulate directly with the audital bullæ. *P. bulleri* differs from the nearly related *P. albinasus* in smaller size, smaller mastoids (which are truncate above instead of rounded), narrower rostrum, narrower and longer nasals, narrower ascending branches of premaxilla, and much shorter angular process of mandible.

Dental characters.—Upper incisors narrow, with a single median furrow; molariform series only slightly heavier than in *G. texensis;* last upper molar with a large heel, which equals or exceeds the anterior prism in antero-posterior diameter.

Measurements.—Average of 2 males from north slope of Sierra Nevada de Colima, Jalisco (measured in flesh): Total length, 236; tail vertebræ, 81.5; hind foot, 33. Average of 4 females from same locality: Total length, 215.5; tail vertebræ, 72.5; hind foot, 30.*

For cranial measurements see Table F, p. 214.

Specimens examined.—Six, all from the north slope of the Sierra Nevada de Jalisco, Mexico.

General remarks.—This species was described almost simultaneously by Mr. Oldfield Thomas and myself, but his description has priority of publication by about a month. Hence his name, *bulleri*, has precedence over my *nelsoni*. Mr. Nelson states that the species "was found only in some fields at the upper ranch at the foot of the main north slope of the Sierra Nevada de Colima, Jalisco, in the upper border of the lower pine belt, at about 6,500 feet altitude, where it was common, and was found in company with the large species, *Geomys gymnurus.*"

Pappogeomys bulleri greatly resembles the bisulcate *Geomys texensis*, from which its dental characters distinguish it at a glance. It is evident that both *bulleri* and *texensis* have undergone but little modifica-

* In my original description of *G. nelsoni*, the measurements were taken "from dry skin of type [♂], slightly overstuffed," the field measurements not having been received (Proc. Biol. Soc., Washington, VII, Sept. 29, 1892, 164.) The measurements as published were: Total length, 250; tail vertebræ, 80; hind foot, 30. The flesh measurements of the same specimen are: Total length, 238; tail vertebræ, 83; hind foot, 33. Mr. Thomas' measurements of his type specimen of *bulleri* are: Head and body, 135; tail, 63; hind feet, with claw, 27.6.

tion since they left the main trunk line of the group, and that both branched off from points not very remote from the place where *Thomomys* left the same stock.

PAPPOGEOMYS ALBINASUS sp. nov.

Type from GUADALAJARA, STATE OF JALISCO, MEXICO. No. $\frac{34138}{46218}$ ♀ ad. U. S National Museum, Department of Agriculture collection. Collected at Atemajac, a suburb of Guadalajara, May 21, 1892, by E. W. Nelson (Original No. 2654).

Geographic distribution.—The plain of Guadalajara; limits of range unknown. Mr. Nelson states: "This species occurs very sparingly on the open plain about Guadalajara, and diggings of a small gopher, probably the same species, were seen near Ahualulco, some 35 miles farther west. The range in altitude of these localities lies between 4,000 and 5,100 feet."

General characters.—Size small; naked nasal pad well developed; tail naked. Animal similar to *P. bulleri* of Thomas, but somewhat larger; nasal pad and white patch above it more elongated; color paler; whiskers finer and less conspicuous.

Color.—Uniform pale plumbeous above and below, irregularly washed with pale chestnut, palest below; a small dark patch around each ear; an elongated white patch on nose inclosing nasal pad and reaching posteriorly nearly to plane of eyes.

Cranial characters.—Skull small, smoothly rounded like *Thomomys;* zygomatic arches parallel, slender, angle not expanded; temporal impressions widely distant; zygomatic breadth slightly exceeding greatest breadth of cranium posteriorly. Skull similar to that of *P. bulleri*, but differing in larger size; much larger mastoids, which are rounded above instead of truncate; broader muzzle; shorter and broader nasals; broader ascending branches of premaxilla, and more elongated angular processes of mandible.

Measurements in flesh.—Type specimen ♀ ad. Total length, 226; tail vertebræ, 68; hind foot, 31.

For cranial measurements see Table F, p. 214.

General remarks.—The only known species requiring comparison with *P. albinasus* is the related *P. bulleri* of Thomas, a smaller and much more highly colored animal, differing in the cranial characters above pointed out. Future investigations may show that the ranges of the two meet, and that the animals intergrade, in which case *albinasus* will become a subspecies of *bulleri.*

Unfortunately, only a single specimen of *Pappogeomys albinasus* is at hand. But since its type locality, Guadalajara, is an attractive and accessible locality. It is probable that a large series of specimens will be obtained in the near future.

Genus CRATOGEOMYS [*] nob.

(Pl. 2; pl. 10, fig. 5; pl. 12, figs. 1 and 2; pl. 13, figs, 4–8, and 17; pl. 14, figs. 6 and 7; pl. 15, figs. 6 and 9; pl. 17, fig. 5; pl. 18, fig. 4; pl. 19, fig. 6.)

Type *Geomys merriami* Thomas, from the VALLEY OF MEXICO (pl. 2).

Dental characters.—Upper premolar with three enamel plates (the posterior absent), its shaft strongly convex forward; upper and lower premolars subequal in length. First and second upper molars with one enamel plate each (posterior absent); posterior curvature of m^1 and m^2 and anterior curvature of m_1 and m_2 strong.

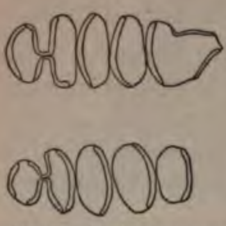

FIG. 59.—*Cratogeomys merriami.* Crowns of molariform teeth: *a*, upper; *b*, lower.

Last upper molar an imperfectly double prism; a deep sulcus on outer side; no sulcus on inner side; crown of tooth normally broader than long, variable in form, usually more or less obcordate or subtriangular; inner and outer enamel plates variable; inner plate normally at least two-thirds as long as anterior plate, obliquely transverse, normally covering posterior face of tooth.

Upper incisor with a single sulcus, median or slightly on inner side, and usually rather open (fig. 21^1, 21^3, and pl. 15, fig. 9).

Cranial characters.—Skull large and massive; zygomata heavy and rather broadly spreading; orbitosphenoids short and broad, articulating with alisphenoids anteriorly; mesethmoid a half crescent, its apex pointing to presphenoid; endoturbinals together forming a compact plate, strongly convex below, straight above, its anterior border sloping strongly backward without any extension of the os planum in front of the folds (pl. 19, fig. 6); first endoturbinal moderately expanded and elongated; second, third, and fourth subequal; vomerine edge of os planum curving down below plane of roof of narial passage; floccular fossa circumscribed and separated from internal auditory meatus by a distinct ridge; ridge separating inner from superior face of petrous sharp and incurved, and sometimes rising high posteriorly (pl. 17, fig. 5, and pl. 18, fig. 4).

The following additional characters, of more or less weight, are introduced with special reference to antithesis with *Platygeomys:* [†] Breadth of cranium posteriorly (above mastoids) much less than zygomatic breadth; breadth of occipital plane not more than twice its height; lambdoid crest broadly convex posteriorly; squamosal expansion chiefly toward the median line (in *C. merriami* in advanced age they completely cover and conceal the parietals, above which they meet in a median crest); mandible longer than broad (including incisors); angular process

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[*] *Cratogeomys*, from κράτος, strong, powerful, + *Geomys*, in reference to the great size and strength of the animals.

[†] Many of the characters already given in the generic diagnosis are also in strong contrast to those of *Platygeomys*.

of mandible short, nearly sessile, truncated externally, and forming a shelf completely around the base of the outer side of the incisor knob; squamosal arm of zygoma covering nearly or quite two-thirds of jugal, which latter fills but a narrow gap in zygomatic arch (except in one species, *C. fulvescens*, in which the jugal is abnormally short posteriorly, its anterior relations being normal); free part of upper edge of jugal half or less than half the length of basioccipital on median line; paroccipital processes relatively light; incisors heavy in contrast to those of *Platygeomys* (except in *fulvescens* and *castanops*); antero-posterior diameter of incisors greater than transverse (except in *fulvescens* and *castanops*); enamel face of lower incisors forming a conspicuous bead on outer side of tooth, behind which the tooth is strongly beveled, the transverse diameter being much greater through the enamel face than posteriorly (except in *fulvescens* and *castanops*).

In *Cratogeomys* a marked depression extends obliquely across the squamosals from the root of the zygoma to the occiput near the median line. In the *gymnurus* series no such depression exists, but, on the contrary, a distinct bulge or elevation occupies this part of the skull.

Cratogeomys splits naturally into two sections: The *merriami* series, comprising *merriami*, *perotensis*, *estor*, *oreocetes*, and *peregrinus;* and the *castanops* series, comprising *castanops* and *fulvescens*. In the *merriami* series the top of the skull seen in profile is a nearly straight line; the zygomata are not strongly decurved, and the outer angle is only moderately expanded. In the *castanops* series the top of the skull is decidedly convex, the zygomata are strongly decurved, and the outer angle is broadly expanded. Numerous other cranial differences exist, and it is probable that the *castanops* series will be eventually separated, at least subgenerically, from *Cratogeomys* proper.

KEY TO SPECIES OF CRATOGEOMYS.

(1) BASIOCCIPITAL *rectangular, its sides parallel*

Rostrum and brain case long .... *castanops*

Rostrum short; brain case broad .... *goldmani*

(2) BASIOCCIPITAL *truncate wedge-shaped* (sides approximating anteriorly).

a^1 *Sagittal crest well developed.*

b^1 Lower incisor strongly beveled on outer side .... *merriami*

b^2 Lower incisor not beveled on outer side.

c^1 Top of skull strongly convex in profile .... *fulvescens*

c^2 Top of skull nearly flat in profile.

Nasals normal (rather long and narrow) .... *perotensis*

Nasals short, narrow posteriorly and broad anteriorly .... *estor*

a^2 *No sagittal crest.**

Outer face of upper incisor strongly beveled .... *oreocetes*

Outer face of upper incisor not beveled .... *peregrinus*

*The only specimens seen of *oreocetes* and *peregrinus* are females; it is possible that the old males may have a crest.

CRATOGEOMYS MERRIAMI (Thomas).

(Pl. 2; pl. 10, fig. 5; pl. 13, fig. 4; pl. 14, fig. 7; pl. 15, figs. 6 and 9; pl. 17, fig. 5; pl. 18, fig. 4; pl. 19, fig. 6).

Geomys merriami Thomas, Annals & Magazine Nat. Hist., Ser. 6, Vol. XII, October, 1893, 271-273. (Type in British Museum.)

Type from "southern Mexico"—probably the VALLEY OF MEXICO.

Geographic distribution.—South end of Valley of Mexico and adjacent mountain slopes from just below the lower edge of the lower pine belt up to an altitude of 10,000 or 11,000 feet; east to Atlixco (Puebla), north to Irolo (Hidalgo), and west to Lerma, in Toluca Valley (map 4, I).

General characters.—Size largest of the genus *Cratogeomys;* tail and hind feet moderately haired but not so well covered as in *C. fulvescens;* skull massive; incisors huge.

Color.—Upper parts dull chestnut brown, mixed with black-tipped hairs, varying to glossy slate black; underparts similar but paler; the rusty specimens have a dark patch around and behind each ear, which is not apparent in the slate-black ones.

Cranial characters.—Skull large and massive, the zygomatic arches widely spreading anteriorly and rapidly narrowing posteriorly (pl. 2); incisor teeth larger and heavier than in any known Mexican species, not excepting *Platygeomys gymnurus;* antero-posterior diameter of incisors much greater than transverse; lower incisors with a strongly marked bevel on the outer side immediately behind the enamel; behind the bevel the tooth is abruptly narrower; outer edge of enamel forming a conspicuous bead. In adult males the squamosals completely cover the parietals and meet in a median crest above the sagittal crest proper. The mandible of the Lerma skull (No. 50110) is longer and narrower across the angular processes than that of specimens from the slopes of the Valley of Mexico. Skulls from Irolo differ from the typical form of the Valley of Mexico in having the mastoids considerably larger and fuller posteriorly, occupying more of the occipital plane. The audital bullæ also are somewhat more swollen. The mastoids do not extend out so far laterally as in typical *merriami;* the postpalatal pits are not so deep; the coronoid processes of the mandible are more spreading (directed more strongly outward), and the heel of the last upper molar is shorter. The Irolo skulls agree with typical *merriami* and differ from the Atlixco specimens in having the frontal reach further forward along the median line than on the sides. Skulls from Atlixco differ from typical *merriami* in the following particulars: The nasals extend further back, reaching or passing plane of fronto-maxillary suture; the frontal reaches as far forward laterally as on median line (in *merriami* it reaches much further forward on median line); as a rule the coronoid processes of mandible are lower and more abruptly curved backward, with the coronoid notch correspondingly narrower.

The massiveness of the incisor teeth in true *merriami* is much more extreme than in any of the other species, and is coördinated, as already pointed out, with a much greater development of the squamosal and of the various prominences and ridges for muscular attachment.

Variations in pelage.—*Cratogeomys merriami* exhibits both the melanistic and chestnut color phases, and also intermediate pelages. In four adult specimens from Tlalpam, three are dark brown, faintly washed with fawn color or very pale fulvous; the fourth is bright chestnut or reddish-brown on the rump and sides, while the newer hair of the back is intimately mixed with blackish. One specimen from Amecameca has a white spot above the tail, as in the Irolo specimens.

All of the three specimens from Irolo have an irregular white patch at the base of the tail above, and one has a small irregular patch on the rump and another on the belly between the hind legs.

In the Irolo specimens the tail is less hairy and the hind feet more hairy than usual, and the hairs of the hind feet are white.

One of the eight specimens from Atlixco has the white spot at the base of the tail, though not so large as in the Irolo and Las Vigas specimens. The hind foot is scant haired in the Atlixco specimens, which peculiarity is probably seasonal, since the Atlixco specimens were collected in July, while those from Irolo were collected in March. The tails are less hairy than usual in the Irolo and Atlixco specimens.

Measurements (taken in flesh).—Average of 11 males from the south end of the Valley of Mexico and adjacent slopes (Amecameca, Tlalpam, Ajusco, Salazar, Huitzilac, and Lerma): Total length, 380; tail vertebræ, 112; hind foot, 50. Average of 7 females from same localities: Total length, 344; tail vertebræ, 105; hind foot, 46.

For cranial measurements see Table D, p. 210.

Specimens examined.—Total number 31, from the following localities: State of Mexico, Tlalpam, 4; Amecameca, 9; Ajusco, 2; Salazar, 1; Lerma, 1; State of Morelos, Huitzilac, 3; State of Hidalgo, Irolo, 3; State of Puebla, Atlixco, 8.

General remarks.—Mr. Nelson states that this large and powerful species is common in the south end of the Valley of Mexico, where it inhabits the soft soil of the bordering slopes and ranges on the west, south, and east sides of the southern two-thirds of the basin. Owing to the hard rock and clayey character of the middle and northern parts of the valley it does not occur there. On the west side it ranges up to the summit of the Sierra de Las Cruces (where he secured a specimen at an altitude of 11,000 feet near Salazar), and thence down the west slope into the border of the valley of Toluca, where a specimen was taken at Lerma. South of the Valley of Mexico it ranges up over the Sierra de Ajusco to an altitude of 10,000 feet, and across to Huitzilac on the south slope within the borders of the state of Morelos. On the east side of the valley it ascends the basal slopes of Mounts Popocatapetl and Iztaccihuatl. On the southeast slope of Popocatapetl it occurs at Tochimilco and on the adjacent plain about Atlixco, Puebla. It was also found at Irolo, Hidalgo, at the extreme north end of the Sierra

Nevada de Iztaccihuatl. Wherever found in agricultural land it is very destructive to corn, wheat, and other crops.

CRATOGEOMYS PEROTENSIS sp. nov.

(Pl. 8, fig. 6.)

Type from Cofre de Perote, Vera Cruz (altitude 9,500 feet). No. 54299 ♀ ad. U. S. Nat. Museum, Department of Agriculture collection. Collected May 28, 1893, by E. W. Nelson. (Original No., 4889.)

Geographic distribution.—*Cratogeomys perotensis* inhabits the west and higher slopes of the Cofre de Perote, which are wooded, and probably descends to the northward to meet the range of *C. estor*. Mr. Nelson's specimens were obtained at the altitudes of 9,500 and 12,000 feet (map 4).

General characters.—Size rather large (smaller than *merriami* but larger than *estor*); no naked nose pad; hind feet and tail rather well haired.

Color.—Upper parts dark russet fulvous, everywhere finely mixed with black-tipped hairs; a small dusky patch behind each ear; an irregular white patch at base of tail in some specimens (in eight out of thirteen); under parts dark plumbeous, more or less washed with fulvous; hind feet usually dark proximally and white distally, but sometimes all white (and not always symmetrical on the two feet). Not one of the thirteen specimens is in the slaty-plumbeous pelage so common in *C. merriami*. This species has the tail more hairy than in the others of the *merriami* series, and in a number of specimens it is irregularly blotched with dusky and white, a peculiarity not observed in any other species.

Cranial characters.—Unfortunately the male of *perotensis* is unknown,* all of the thirteen specimens collected by Mr. Nelson on the Cofre de Perote being females. The skull of the female, however, furnishes excellent characters. It agrees with *merriami* in general form, in having the profile of the top of the skull a nearly straight line (not convex as in *fulvescens* and *castanops*) and in having a well developed sagittal crest. Whether or not the squamosals completely overlap the parietal in the adult male, as they do in *merriami*, is not known, but they probably do. Aside from its much smaller size, the skull of the ♀ *perotensis* may be distinguished at a glance from that of *merriami*, and from all other known species of *Cratogeomys*, by the slenderness of the jugal anteriorly. The jugal is not at all enlarged anteriorly, and is deeply mortised into the maxillary arm of the zygoma (see pl. 13, fig. 5).

*Unless one of the specimens obtained near Las Vigas (No. 54311) belongs to this species instead of *estor*. It is an immature male, too young to place the identity beyond question, but has the characters a young male *perotensis* would be expected to possess. The skull as a whole is larger than the adult female of *perotensis* (and hence considerably larger than *estor*); the rostrum and nasals are longer; the jugal is broader anteriorly, and the squamosals have already crept up over part of the parietals and would undoubtedly meet in advanced age.

In some instances the squamosal arm of the zygoma reaches so far forward and the maxillary arm so far backward that the two nearly meet above the jugal. The nasals end on or near the plane of the front of the zygoma, and the ascending branches of the premaxilla reach back past the plane of the lachrymals, thus leaving a long median projection of the frontal between the hinder ends of the premaxillaries. Skulls of *perotensis* may be distinguished from those of *estor* (from the lower northeast slopes of the same mountain) by larger size, much greater length of rostrum and nasals, slenderness of jugal anteriorly, greater length of sagittal crest, and by the form of the frontal between the orbits, which is broadly rounded instead of flat.

Measurements (taken in flesh).—Type: Total length 300; tail vertebræ 79; hind foot 40.

Average measurements of twelve females from type locality: Total length 310; tail vertebræ 88; hind foot 41.5.

For cranial measurements see Table D, p. 210.

Specimens examined.—Thirteen, all from Cofre de Perote, Vera Cruz.

CRATOGEOMYS ESTOR sp. nov.

(Pl. 8, figs. 4 and 5.)

Type from LAS VIGAS, VERA CRUZ (altitude 8,000 feet). No. 54308 ♂ ad. U. S. Nat. Museum, Department of Agriculture collection. Collected June 12, 1893, by E. W. Nelson. (Original No. 5005.)

Geographic distribution.—The pine-covered hills and flats forming the extreme northeastern foothills of the Cofre de Perote, and also the belt of pine forest connecting the timber of the mountain with the wooded hills of the north. Its range is chiefly east and north of that of *perotensis*. *C. estor* thus reaches the extreme eastern edge of the table-land. Mr. Nelson's specimens were obtained at an altitude of about 8,000 feet (map 4, K).

General characters.—Size medium (smaller than *perotensis*); naked nasal pad small or absent; hind feet and tail rather well haired, as in *perotensis*.

Color.—Upper parts dark russet fulvous, everywhere finely mixed with black-tipped hairs; a small dusky patch behind each ear; an irregular white patch at base of tail above (on all ten specimens) and sometimes one below also; under parts dark plumbeous, more or less washed with fulvous; hairs of hind feet whitish, usually to ankle. Not one of the ten specimens is in the melanistic or slaty-plumbeous pelage so common in *merriami*.

Cranial characters.—Skull similar to that of *perotensis* in general form and profile, the top of the skull a nearly straight line—not strongly convex as in *fulvescens* and *castanops*. Contrasted with *perotensis* (the only species with which it requires comparison) *C. estor* differs in the following characters: Size smaller (♂ of *estor* about equaling ♀ of *perotensis*); rostrum much shorter; nasals shorter and broader anteriorly; jugal broader anteriorly and less deeply embeded between forks of maxillary arm of zygoma; frontal broader interorbitally on top of skull, and flat instead of broadly rounded; sagittal crest shorter anteriorly and perhaps not present in the female. The female with distant temporal impressions (No. 54306) figured on pl. 8, fig. 4, is not fully adult; in advanced age the sagittal area is probably nearly or quite obliterated by union of the temporal ridges.

Measurements (taken in flesh).—Type (♂ ad.): Total length 315; tail vertebræ 94; hind foot 41.

Average measurements of four males from type locality: Total length 313; tail vertebræ 89; hind foot 42.

Average measurements of four females from same place: Total length 277; tail vertebræ 75; hind foot 37.

For cranial measurements see Table D, p. 210.

Specimens examined.—Ten, all from Las Vigas, Vera Cruz.

General remarks.—*C. estor* resembles *C. perotensis* so closely in color and external characters that the two are practically indistinguishable except in size, *estor* being decidedly the smaller. In cranial characters, however, they are quite distinct, as pointed out above.

Mr. Nelson states that wherever the pine forests are cleared away and the ground cultivated within the range of this species, the animal multiplies rapidly and becomes exceedingly destructive to crops.

CRATOGEOMYS OREOCETES sp. nov.

(Pl. 8, figs. 1 and 2.)

Type from Mount Popocatapetl, Mexico (altitude, 11,000 feet). No. 57963 ♀ yg. ad. U. S. National Museum, Department of Agriculture collection. Collected January 7, 1894, by E. W. Nelson and E. A. Goldman. (Original No. 47.)

Geographic distribution.—The boreal higher slopes of Mount Popocatapetl, above the range of *Cratogeomys merriami* (above 11,000 feet altitude.)

General characters.—Incisor sulcus broadly open and wholly on inner side; size rather large; pelage soft; nasal pad small; hind feet and tail sparsely haired.

Color (of type specimen).—Dusky, darkest on head and along median part of back; tips of hairs washed with pale brown; a golden brown patch under each eye; forefeet dusky; hind feet white. Apparently the specimen is just beginning the change from the plumbeous to the brown pelage.

Cranial characters.—Zygomatic arches narrow, their sides nearly parallel; anterior angle moderately expanded (about as in *Heterogeomys hispidus*); temporal ridges strongly developed; nasals wedge-shaped, not inflated anteriorly, ending posteriorly in front of plane of anterior face of zygoma; ascending branches of premaxilla just reaching plane of orbit, not divaricating behind nasals; frontal flat (orbital edges rounded), rather broad interorbitally and posteriorly, reaching forward between premaxillæ much further than laterally; supraorbital prominences not strongly developed; temporal ridges anterior to interparietal straight, inclosing an elongated wedge-shaped interspace (but very different from the interspace between the strongly curved ridges of *H. hispidus*); interparietal elongated antero-posteriorly, very much longer than broad; jugal long and large, forming an important part of arch; lambdoid crest strongly and evenly convex posteriorly; occipital plane flat, sloping slightly forward from below upward; posterior ends of palatals excavated laterally; pterygoids narrow lingulæ with parallel sides, as in *C. merriami;* audital bullæ relatively short and swollen, more subglobular than in *H. hispidus;* brain case rising abruptly from posterior roots of zygomata, much as in *hispidus* (not flatly rounded as in the *merriami* group and in *peregrinus*). Under jaw short and rather narrow, as in *hispidus;* angular processes short.

Dental characters.—Face of upper incisors unisulcate, the groove wholly on inner side and broadly open, as in *merriami*—not narrow and deep as in *H. hispidus* and *M. heterodus;* breadth of enamel face of upper incisor slightly greater than antero-posterior diameter of tooth; outer side of tooth strongly beveled immediately behind enamel, as in the lower incisor of *merriami*. Lower incisor narrow, the transverse diameter less than the antero-posterior. Crown of last upper molar much broader than long; no distinct heel; the inner side convex, the outer side emarginate and longer. The curvature of the prism of this tooth is much less than in the *merriami* series and less than in *H. hispidus*.

The premolar is the longest tooth and is slightly convex anteriorly; m^1 and m^2 are hardly shorter and are subequal (or m^2 may be slightly the shorter); both are strongly convex anteriorly; m^3 is more than two-thirds the length of m^2 and is only moderately convex anteriorly.

Measurements (taken in flesh).—Type specimen: Total length, 318; tail vertebræ, 92; hind foot, 43.

For cranial measurements see Table D, p. 211.

General remarks.—*Cretogeomys oreocetes* does not require close comparison with any known species. From its nearest neighbor of the lower slopes of the same mountain (*C. merriami*) it differs conspicuously in smaller size, narrower zygomata, shorter and more globular audital bullæ, and in the presence of strongly developed temporal ridges.

From *C. peregrinus*, which inhabits the corresponding boreal slopes of the neighboring mountain, the lofty Iztaccihuatl, it may be distinguished by its narrower and higher cranium, by the beveled outer face of the upper incisor, the convex (instead of notched) inner border of crown of last upper molar, and other characters mentioned under that species.

The measurements of the skull of *C. oreocetes* (see table D) show that the posterior breadth of the cranium is nearly equal to the zygomatic breadth. This is due to the narrowness of the zygomatic arches—not to any unusual breadth of the cranium posteriorly.

CRATOGEOMYS PEREGRINUS sp. nov.

(Pl. 8, fig. 3.)

Type from MOUNT IZTACCIHUATL, MEXICO (altitude 11,500 feet). No. 57964 ♀ old, U. S. National Museum, Department of Agriculture collection. Collected January 9, 1894, by E. W. Nelson and E. A. Goldman. (Original No. 50.)

Geographic distribution.—The boreal higher slopes of Mount Iztaccihuatl, above the range of *Cratogeomys merriami* (above 11,500 feet altitude).

General characters.—Size medium or rather large; hind foot and tail scant haired; nasal pad small; forefoot large (with claws nearly equaling hind foot with claws). Color peculiar.

Color (of type and only specimen).—Steel gray from the intimate admixture of dusky and whitish hairs; under parts paler than upper; throat, sides of face, and fore feet darker. The hairs of the hind foot are whitish; of the tail dusky.

Cranial characters.—The skull of the type, a very old female, has the posterior part of the cranium very flat and broad, and the zygomata broad and bowed outward, suggesting *Platygeomys fumosus*. In other respects the resemblances are more in the direction of *Cratogeomys merriami*, with a few characters pointing toward *Heterogeomys*. The zygomatic arches are widely spreading, not divergent anteriorly but broadest across the middle (breadth anteriorly slightly less than greatest breadth of squamosals posteriorly); the anterior roots stand out at nearly a right angle; the antero-external angle is moderately expanded and sharply angular when seen from the side; rounded as seen from above. The jugal is rather large and forms an important part of the arch as in *C. merriami*. The muzzle and nasals are short, the latter broad anteriorly and truncated posteriorly about on the plane of the anterior face of the zygomata. The ascending branches of the premaxilla are broad and blunt posteriorly, barely reach the plane of the orbits, and do not approximate or divaricate behind the nasals. The frontal reaches furthest forward along the median line; the suture at base of maxillary root of zygoma (on top of skull) is nearly a straight line. There is no sagittal crest, but the temporal ridges approximate immediately in front of the interparietal, from which point they divaricate in both directions; anteriorly they slope slightly outward in nearly a straight line to a point about opposite the posterior part of the postorbital prominences of the frontal where they become less distinct and curve abruptly outward. The interspace is an elongated wedge, as in *C. oreocetes*, and is not depressed below the level of the temporal ridges, a result perhaps of the extreme age of the animal. In shape it differs widely from that of the genus *Heterogeomys*. The great breadth of the cranium posteriorly is due to lateral expansion of the squamosals, as in *Platygeomys*. The greatest breadth across squamosals (over mastoids) is slightly greater than the zygomatic breadth anteriorly. The interparietal is not covered by the parietals and is elongated antero-posteriorly. The plane of the occiput is moderately smooth and slopes forward; it is low and broad, the breadth being about two-and-a-half times the height. The mastoid bullæ are much as in *merriami*, except that the inferior border is shorter and the inner side is armed with a short blunt spine projecting inward and slightly backward. (This may be abnormal, but the points are symmetrical on the two sides.) The audital bullæ are rather short and tumid (much as in *oreocetes*) and the anterior projection which abuts against the basisphenoid is sharply set off by a deep notch on the upper side. The palatopterygoids are lingulate, slightly broader than in *merriami*, the sides nearly parallel; mandible short and narrow, resembling that of *oreocetes*, from which it differs in having the angular processes even shorter and the coronoids more hooked.

Dental characters.—Upper incisors with a single very broad and open groove (broader even than in *oreocetes*), its deepest point on the inner side of the median line; breadth of enamel face greater than antero-posterior diameter of tooth. Lower incisors narrow, the breadth of the enamel face being considerably less than the antero-posterior diameter of tooth. Crown of last upper molar not distinctly heeled, its inner border about half the length of outer and deeply notched; outer side broadly concave.

Measurements (taken in flesh).—Type specimen: Total length, 304; tail vertebræ, 87; hind foot, 42.

For cranial measurements see Table D, p. 211.

CRATOGEOMYS CASTANOPS (Baird).

(Pl. 12, fig. 1; pl. 13, fig. 17; pl. 14, fig. 6.)

Pseudostoma castanops Baird, Report Stansbury's Exp'd. to Great Salt Lake, June 1852, 313. (Type from near Bents Fort, Colorado.)
Geomys castanops Baird, Mammals of North America, 1857, 381–386.
Geomys clarkii Baird, Proc. Acad. Nat. Sci., Phila., VII, 1855, 332. (Type from Presidio Del Norte, on the Rio Grande, Chihuahua, Mexico.)

Type locality: "Prairie road to Bents Fort," near the present town of LAS ANIMAS, COLORADO, on the Arkansas River. (Type in U. S. National Museum.)

Geographic distribution.—Isolated areas on the Great Plains from the Arkansas River in Colorado, southward through eastern New Mexico (west to Albuquerque), and western Texas to Santa Rosalia, Chihuahua, and Jaral, Coahuila (map 4, II).

General characters.—Size, medium; coloration, yellowish-brown; tail of medium length; rather scant haired.

Color.—Upper parts yellowish brown or buffy ochraceous tinged with yellowish, more or less mixed with black-tipped hairs, which are much more numerous in winter pelage; under parts buffy.

Cranial characters.—Skull very broad and heavy; zygomatic arches widely spreading anteriorly and strongly decurved; profile of skull convex on top; end of maxillary root of zygoma greatly expanded, forming a broad plate, into which the enlarged head of the jugal is received; *sides of basioccipital parallel. C. castanops* differs from *C. fulvescens* in having the basioccipital narrow, its sides excavated and parallel; the nasals and nasal branches of the premaxilla more produced posteriorly; the latter cutting the plane of the orbits, and in lacking the thickened sockets of the upper incisors.

Measurements (taken in flesh.)—An adult male from Las Animas, Colorado (practically type locality): Total length, 295; tail vertebræ, 95; hind foot, 37.

Average of 3 females from same locality: Total length, 256; tail vertebræ, 77; hind foot, 33.

For cranial measurements see Table D, p. 211.

Specimens examined.—Total number 43, from the following localities: Olney, Colorado, 2; Las Animas, Colorado (type locality), 6; Chico Springs, New Mexico, 2; Albuquerque, New Mexico, 3; Eddy, New Mexico, 3; Sierra Blanca, Texas, 1; Marfa, Texas, 3; Eagle Pass, Texas, 13; Samalayuca, Chihuahua, Mexico, 2; Gallego, Chihuahua, Mexico, 2; Santa Rosalia, Chihuahua, Mexico, 4; and Jaral, Coahuila, Mexico, 5.

General remarks.—Coues has already shown that *clarkii* can not be distinguished from *castanops*, and the examination of a much larger series than heretofore available confirms this determination. The peculiar line of demarkation in the type specimen* described by Baird as separating the color of the head and neck from that of the rest of the upper parts, is now well known as the molt line (which progresses from before backward); and the alleged differences in the feet and skull do not hold good in the ample series (forty-three specimens) now at hand. The species presents considerable geographic variation in size (mostly sporadic), as usual in members of the family having an extensive range. The only notable departure from the type observed in the present series is in two specimens from Chico Springs, N. Mex. These specimens are smaller than the type form, brighter and more 'yellowish-chestnut' in color, and the fore feet, hind feet, and tail are distinctly blackish. The tail furthermore is well covered with hair for its entire length.

Mr. Vernon Bailey tells me that *Cratogeomys castanops* is a very injurious species to orchards and nurseries. Along Onion Creek, 30 miles southwest of Marfa, in Presidio County, Texas, he found them eating the roots of fruit trees where "two or three soon spoil an orchard if left in it; the owners did not know how to get rid of them."

CRATOGEOMYS CASTANOPS GOLDMANI subsp. nov.

Type from CAÑITAS, ZACATECAS, MEXICO. No. 57965 ♀ yg. ad. U. S. National Museum, Department of Agriculture collection. Collected December 24, 1893, by E. A. Goldman. (Original No. 286.)

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*The type specimen, formerly in the Patent Office, is now in the National Museum, but is in very poor condition, having been exposed to the light for nearly forty years, as a result of which it is so faded that no trace of the original color remains.

General characters.—Similar to *C. castanops* in size and external appearance, but differing in cranial characters. Tail and hind feet rather well haired for a Pocket Gopher.

Color.—Upper parts dull buffy-ochraceous, moderately mixed with black-tipped hairs; under parts paler.

Cranial characters.—Unfortunately all of the five specimens at hand of this form are females. Compared with females of *C. castanops* the skulls differ in being broader, shorter, and flatter, with less decurved zygomata, and decidedly shorter and broader nasal bones. The shortening is chiefly in the rostrum; the broadening chiefly in the brain case. The basioccipital averages longer and somewhat larger and its sides are less truly parallel, being a little broader posteriorly than anteriorly. The plane of the occiput is narrow and much elongated transversely. The coronoid process of the mandible is long, depressed, and reaches far back.

Measurements (taken in flesh).—Type: Total length, 270; tail vertebræ, 90; hind foot, 35.

Average measurements of three females from type locality: Total length, 257; tail vertebræ, 83; hind foot, 34.3.

For cranial measurements see Table D, p. 211.

Specimens examined.—Total number 5, all from Cañitas, Zacatecas.

CRATOGEOMYS FULVESCENS sp. nov.

(Pl. 12, fig. 2.)

Type from CHALCHICOMULA, STATE OF PUEBLA, MEXICO. No. 58168 ♂ ad. U. S. National Museum, Department of Agriculture collection. Collected January 15, 1894, by E. W. Nelson and E. A. Goldman. (Original No. 5651.)

Geographic distribution.—The basin-like plain of eastern Puebla, Mexico, from Esperanza north to Perote and west to the northeast base of Mount Malinche in Tlaxcala (map 4, J).

General characters.—Upper incisors unisulcate; forefeet shorter than hind feet. Similar in general appearance to *C. castanops*, but larger; color darker; tail rather longer, darker, and slightly more hairy.

Color.—Upper parts grizzled yellowish-brown, liberally mixed with dark-tipped hairs; under parts buffy-fulvous or ochraceous-buff. Compared with *castanops* the general color is darker, owing to more bountiful admixture of dark-tipped hairs.

Cranial characters.—Skull rather massive; zygomata squarely spreading, angles broadly expanded; alveoli of upper incisors thickened; profile of top of skull very convex; rostrum decurved anteriorly.

The fronto-maxillary suture is peculiar, its anterior end usually reaching or nearly reaching the plane of the front of the zygoma—in all the allied species the frontal ends about opposite the middle of the anterior root of the zygoma.

The height of the roof of the cranium above the palate, and of the brain case above the posterior roots of the zygomata, are much greater than in any other member of the genus, and the breadth of the skull posteriorly is much less.

Contrasted with *C. castanops* the skull of *fulvescens* differs in the following particulars: size larger; rostrum broader; sockets of upper incisors thicker, bulging externally; nasals and ascending branches of premaxilla shorter posteriorly, the former hardly reaching plane of front of zygoma, the latter not reaching plane of orbits; basioccipital much broader and wedge-shaped, as usual in the genus (in *castanops* the basioccipital is narrower and its sides are parallel, see pl. 12, figs. 1[a] and 2[a]).

Measurements (taken in flesh).—Type specimen (♂): Total length, 318; tail vertebræ, 102; hind foot, 43.5.

Average of three males from type locality: Total length, 327; tail vertebræ, 105; hind foot, 43.

Average of six females from type locality: Total length, 302; tail vertebræ, 97; hind foot, 39.6.

For cranial measurements see Table D, p. 211.

Specimens examined.—Total number 11, from the following localities: Chalchicomula, Puebla, 9; Perote, Vera Cruz, 2.

General remarks.—*C. fulvescens* does not require close comparison with any known species except *C. castanops*, which it resembles in the grizzled yellowish-brown color of its upper parts. It is more fulvous than *castanops*, from which it differs further in larger size and in the cranial characters above pointed out. Specimens from Perote are more yellowish and less fulvous than those from Chalchicomula.

Mr. Nelson states that this species inhabits the sandy open plain from an altitude of 8,000 feet in the lower parts of the basin up to 9,000 feet on the west slope of Mount Orizaba. He states further: "In this district its range is almost identical with that of *Dipodomys phillipsi*. Like the latter species it follows up the cultivated land into the lower border of the pine forest on Mount Orizaba, and is common also about the northeast base of Mount Malinche. These gophers are particularly numerous in cultivated ground, and are very destructive to corn and grain of all kinds."

Genus PLATYGEOMYS * nob.

(Pl. 3; pl. 10, fig. 8; pl. 13, figs. 1–3; pl. 14, fig. 9; pl. 15, fig. 7; pl. 17, fig. 4; pl. 18, fig. 5; pl. 19, fig. 7.)

Type Geomys gymnurus Merriam, from ZAPOTLAN, JALISCO, MEXICO.

Dental characters.—Upper premolar with three enamel plates (the posterior absent), its shaft nearly straight. First and second upper molars with one enamel plate each (posterior absent).

* *Platygeomys*, from πλατύς, broad, wide, + *Geomys*, with reference to the great breadth of the cranium.

Third upper molar an incomplete double prism, the outer side abruptly narrowed behind the anterior prism; axis of heel antero-posterior; inner enamel plate normally less than two-thirds as long as anterior plate; not covering posterior face of tooth; outer plate normally as long as inner and usually reaching posterior edge of heel.

Upper incisor strongly *unisulcate*, the sulcus median or slightly on inner side (fig. 21[2]).

Cranial characters.—Skull large, heavy, and flat; hinder part of cranium extraordinarily broad and flat, the great breadth due chiefly to lateral expansion of the squamosals, which not only project as a thin shelf beyond the brain case, increasing the size of the glenoid fossa both anteriorly and posteriorly, but also completely arch over and conceal the postglenoid notch, curving with only a shallow concavity from the posterior angle of the zygomatic arch to and beyond the extreme tip of the transversely elongated mastoid; zygomatic arches massive, broadly spreading anteriorly, the antero-external angle expanded vertically into a triangalar plate between the strongly produced and decurved external angle and the evenly rounded orbit (the resulting plate made up in part of the distal end of the maxillary arm of the arch, and in part of the anterior end of the jugal, which is usually expanded); jugal normally large and broad, forming an important part of the arch; pterygoids vertical lamellæ with inferior border everted; orbitosphenoids larger than in *Cratogeomys* but not normally articulating with alisphenoid; mesethmoid a little more than a half crescent, its anterior border strongly rounded above (pl. 18, fig. 5); endoturbinals together forming an elongated oblique plate which is sharply pointed antero-superiorly, owing to the elongation of the upper endoturbinals (pl. 19, fig. 7); no extension of os planum in front of lower endoturbinals and no curving down of vomerine edge of os planum below plane of roof of narial passage; floccular fossa ill defined and not separated from internal auditory meatus by a distinct ridge; ridge separating superior from inner surface of petrous only feebly developed (pl. 17, fig. 4; and pl. 18, fig. 5).

In addition to the above-described generic characters, most of which are in strong contrast to those of *Cratogeomys*, the following points are selected with special reference to antithesis with *Cratogeomys* (which see): Breadth of cranium posteriorly (above mastoids) equal to or greater than greatest zygomatic breadth; breadth of occipital plane at least two and a half times its height; lambdoid crest sinuous, presenting three posterior concavities; squamosal expansion chiefly away from median line—not covering inner part of parietals; mandible very much broader than long* (including incisors); angular processes of mandible

* The extraordinary breadth of the mandible across the angular processes is not due alone to the great length of these processes, but in part to their position. They are higher and more nearly on a level with the incisor protuberance than in any other form, and the jaw as a whole is flatter.

extraordinarily long and spreading, reaching out so far laterally that the knob over root of incisor is midway between condyle and end of angular process (pl. 3); squamosal arm of zygoma covering about half (in *fumosus* more than half) of upper edge of jugal, which latter enters broadly into formation of zygomatic arch; free part of upper edge of jugal equal to length of basioccipital on median line (except in *fumosus*); paroccipital processes large and expanded, forming recurved flanges; incisors slender in contrast to those of the *merriami* series; antero-posterior and transverse diameters of incisors subequal; enamel face of lower incisors forming an inconspicuous bead on outer side of tooth, behind which the tooth is not beveled, the transverse diameter through the enamel face being inappreciably greater than posteriorly.

KEY TO SPECIES OF PLATYGEOMYS.

1ª *Zygomatic arches parallel or bowed outward in the middle* .... *fumosus*
1ᵇ *Zygomatic arches strongly divergent anteriorly:*
  Jugal only slightly expanded anteriory .... *planiceps*
  Jugal broadly expanded anteriorly:
    Nasals strongly wedge-shaped; narrow posteriorly; reaching plane of zygoma .... *gymnurus*
    Nasals not wedge-shaped; broad posteriorly; not reaching plane ot zygoma .... *tylorhinus*

PLATYGEOMYS GYMNURUS Merriam.

(Pl. 3; pl. 10, fig. 8; pl. 13, fig. 2; pl. 15, fig. 7; pl. 17, fig. 4; pl. 18, fig. 5; pl. 19, fig. 7.)

Geomys gymnurus Merriam, Proc. Biol. Soc. Washington, VII, Sept. 29, 1892, 166-167.

Type locality.—ZAPOTLAN, JALISCO, MEXICO. (Type in U. S. National Museum.)

Geographic distribution.—Valley of Zapotlan and adjacent slopes of the Sierra Nevada de Colima, Jalisco, and the volcano of Colima down to the upper edge of the plain of Colima, Mexico.

General characters.—Size very large; a naked pad on end of nose; tail naked; feet sparsely haired; hinder part of cranium extraordinarily broad.

Color.—Upper parts dark reddish-brown or chestnut, varying to sooty plumbeous or slate-black, slightly paler below. The rusty specimens have a dusky patch about each ear and a larger one on the nose. The depth of the chestnut seems to increase with the age of the hair, specimens in the molt having the new hair very dark and only washed on the tips with chestnut. The hairs of the hind feet are scattered and nearly colorless. The young are glossy slate-black, with the sides and rump conspicuously sprinkled with whitish bristles.

Cranial characters.—The skull of *Platygeomys gymnurus* differs from all others of the family (except the related *P. tylorhinus* and *planiceps* here described) in the extraordinary breadth and flatness of the hinder part of the brain case, the result of lateral expansion of the squamosals, which completely arch over and conceal the postglenoid notch, curving with a shallow concavity from the posterior angle of the zygomatic arch to the extreme tips of the transverely elongated mastoids, which they overreach. The breadth of the cranium here equals or exceeds the greatest zygomatic breadth. Corr elated with this unprecedented breadth of the posterior part of the cranium is an even more extreme lateral extension of the angular processes of the mandible. The zygomatic arches are widely spreading anteriorly, with broadly expanded subtriangular outer angles. The jugals are large, broadly expanded anteriorly, enter largely into the outer wall of the orbital fossa, and, as a rule, terminate anteriorly in a straight edge, which articulates with the lower third of the ascending or maxillary arm of the zygoma without being mortised into it as usual in the group; still the front of the jugal rests on a strong shelf of the maxillary arm, and is commonly overtopped by a short spicule. The exposed part of the upper edge of the jugal forming part of the outer wall of the orbital fossa is usually, though not always, as long as the basi-occipital (on median line), and as a rule the posterior half of the jugal is overlapped by the squamosal arm of the zygoma. The fronto-maxillary suture is straight or slightly convex outward, while its continuation as the premaxillo-maxillary suture (on top of the skull) is strongly concave inward, the result being that the suture at the base of the maxillary arm of the zygoma, taken as a whole, is shaped like the letter S somewhat drawn out. In *tylorhinus* and *planiceps* it is broadly and uniformly convex inward. The nasals end posteriorly on or a little behind the anterior plane of the zygoma, and are strongly wedge-shaped and much narrower posteriorly than in *tylorhinus*. The nasal branches of the premaxilla may or may not reach the plane of the orbits; they approximate slightly behind the nasals.

The occipital plane is exceedingly broken and irregular; the lambdoid crest overhangs it as a sinuous ledge throughout its entire length; the greatly enlarged paroccipital processes stand out like broad flanges from the exoccipitals, projecting strongly outward and backward, forming, in conjunction with the middle part of the lambdoid crest, a remarkable basin-shaped inclosure, outside of which, and far anterior to the great paroccipital flanges, are the transversely-elongated mastoids (pl. 15, fig. 7). In striking contrast is the smoothly planed-off occiput of *Heterogeomys hispidus* (pl. 15, fig. 4).

The shape of the lambdoid crest is peculiar; it is deeply sinuous, with three concavities directed forward (of which the median is deep, the lateral shallow), and two strong convexities directed backward; at each end it terminates in a club-shaped knob directed outward. Looking at the skull from above there is nothing to indicate the limits of the brain case, the broad squamosals being convex upward behind the zygomata, without trace of the lateral depression that marks off the brain case in *Cratogeomys* and most other members of the family.

Measurements (taken in flesh).—Average of three males from type locality (Zapotlan, Mexico): Total length, 352.6; tail vertebræ, 105.3; hind foot, 53.3. Average of three females from same place: Total length, 341; tail vertebræ, 91; hind foot, 49.6.

For cranial measurements see Table E, p. 212.

Specimens examined.—Total number, 10, from the following localities in Jalisco, Mexico: Zapotlan, 7; Sierra Nevada de Colima, 3.

General remarks.—*Platygeomys gymnurus* may be regarded as the type (for it is the largest and most extreme in cranial peculiarities) of a remarkable series of Pocket Gophers inhabiting southern Mexico from the Sierra Nevada de Colima of Jalisco eastward to the north slope of the Volcan Toluca in the State of Mexico, and Tula in Hidalgo. Externally these animals differ so little from the larger species of *Cratogeomys* as to be distinguished with difficulty, but in cranial characters they may be told at a glance. The number of recognizable forms now known is four, of which one (*fumosus*) is very distinct from the others; the remaining three are closely related (*gymnurus*, *tylorhinus*, and *planiceps*) and two of them (*tylorhinus* and *planiceps*) may be found to intergrade when specimens are obtained from intermediate localities along the line of their distribution, in which event the latter must be reduced to subspecific rank. Still another form that might be deemed worthy of separation is the Patzcuaro animal mentioned under the head of *P. tylorhinus*.

All the members of the *gymnurus* series have the upper parts more or less plentifully sprinkled with long, slender, bristle-like hairs which protrude far beyond the ordinary fur. In *fumosus* these hairs are very conspicuous, owing to the marked contrast of their whitish color with the blackish-slate of the body; the same is true of the young in *gymnurus*, but in the adult they harmonize so well with the prevailing reddish-brown or chestnut tints that they may be easily overlooked. They are most abundant in the Patzcuaro specimens of *tylorhinus*.

Mr. Nelson states that the range of *Platygeomys gymnurus*, so far as determined by him, is limited to the valley of Zapotlan and slopes of the Sierra Nevada de Colima and base of the adjacent volcano of Colima, and the immediate vicinity. On the north slope of the Sierra Nevada de Colima he found them up to an altitude of 11,000 feet, among the firs and alders, where a specimen was secured. Thence to the base of the mountain they are rather common on open grassy slopes, and range out over all of the adjacent valley of Zapotlan. In this latter district they were usually found in fields, where they do much damage to corn and wheat. Zapotlan Valley has an altitude of about 4,500 feet, and is an open basin-like plain just below the pines and oaks of the mountains. On the extreme upper border of the plain of Colima, near the southwest base of the volcano, at an altitude of about 3,500 feet, he saw numerous diggings of a gopher, which was probably this species.

PLATYGEOMYS TYLORHINUS sp. nov.

(Pl. 13, fig. 1.)

Type from TULA, HIDALGO, MEXICO. No. 51883 ♂ ad. U. S. National Museum, Department of Agriculture collection. Collected March 13, 1893, by E. W. Nelson. (Original No. 4442.)

Geographic distribution.—Tula, Hidalgo, and thence southwesterly along the north slope of the Sierra Madre to the vicinity of Patzcuaro, Michoacan.

General characters.—Size, large; tail nearly naked; a naked pad on end of nose; coloration dark. Similar to *P. gymnurus*, but smaller, with shorter and more hairy hind feet, which are distinctly white in contrast to dark of ankles and legs; skull remarkably broad and flat, as in *P. gymnurus*, but lighter and differing further in important characters.

Color.—Upper parts chestnut or liver-brown, as in *Geomys bursarius;* under parts similar but slightly paler, the plumbeous showing through in places; legs and ankles concolor with body; hind feet white in contrast.

Cranial characters.—Skulls of *P. tylorhinus* differ from those of *P. gymnurus* in smaller size, narrower rostrum, and shorter nasals, which do not reach plane of zygomatic arches. The most conspicuous difference is in the shape of the nasals: instead of being wedge-shaped, as in *gymnurus*, they are much broader posteriorly and abruptly truncated behind, and the premaxillæ do not approximate behind them. The skull as a whole is much less massive and the maxillary arm of the zygoma less thickened than in *gymnurus*. The jugal is enlarged throughout and expanded anteriorly into a broad plate which abuts against the sides of the maxillary part of the zygomatic arch, which latter is hardly excavated to receive it, sending out a small shelf below and a short spicule above, much as in *gymnurus*. The suture at the base of maxillary root of zygoma is broadly convex inward; in *gymnurus* it is shaped like a drawn-out S. As usual, the skull of the female is much smaller than that of the male, and the jugal is narrower.

Measurements (taken in flesh).—Type specimen, ♂ ad.: Total length, 345; tail vertebræ, 100; hind foot, 45. Average of two ♀ specimens from type locality: Total length, 298; tail vertebræ, 91.5; hind foot, 39.5.

For cranial measurements see Table E, p. 212.

Specimens examined.—Total number 9, from the following localities in Mexico: Tula, in Hidalgo, 4; Patzcuaro, in Michoacan, 5.

General remarks.—Specimens from Patzcuaro, State of Michoacan, are intermediate in size and form of nasals between *gymnurus* and typical *tylorhinus* from Tula, but exceed the latter in the expansion of the jugal and whiteness of the hind feet. The hind feet are more hairy, and the ankles are dark plumbeous instead of chestnut, causing the white to stand out in stronger contrast. Skulls of the Patzcuaro animal differ further from those from Tula in having smaller and shorter pterygoid lamellæ (as seen from the side), leaving more space between their posterior edge and the audital bullæ. The posterior ends of the palatals are smaller, thicker, and have the outer edge straighter. In the Tula skulls the palatals are thinner and broader, with the outer edge irregularly sinuous. In the Patzcuaro animal the jugals are conspicuously broader anteriorly than in those from Tula, but as in the latter they are much less expanded in the female than in the male.

There is an average difference in external characters by which the Patzcuaro specimens may be distinguished from specimens from Tula and the Volcano of Toluca. They are darker and richer in color (the chestnut being more ferruginous), and the head is mainly slate black, more or less faintly washed with rusty. This color does not cover the head uniformly but is disposed in a tolerably regular pattern from which there is little variation in the series of specimens at hand. The slate-black covers the muzzle, reaching back along the median line as far as the plane of the eyes, and sends a broad arm backward on each side to the shoulders, inclosing the eye and ear. The chestnut of the back comes forward over the top of the head to about the plane of the eyes, and on the sides of the face below the eyes to and sometimes including the cheeks. Possibly there is something seasonal in this pelage; all of the Patzcuaro specimens were collected at the same time—the latter half of July.

Mr. Nelson contributes the following information respecting the local distribution of *P. tylorhinus:* "I found this species common along the north slope of the mountains about Lake Patzcuaro and thence to the vicinity of Lake Cuitzeo, in Michoacan. All of this district lies in the zone immediately below the pines (from about 5,500 to 6,800 feet altitude), and is largely cultivated to wheat and corn. The gophers are particularly numerous in the fields, where they do considerable damage to crops. They range up into the lower border of the forest where *Zygogeomys trichopus* is found. Beyond Lake Cuitzeo no work was done to the northeast until Tula, Hidalgo, was reached. There these animals were found in small numbers at an altitude of about 6,000 feet, in the vicinity of the town. They were only noted about the borders of small basin-like sinks, where the land was under cultivation. Not being numerous here their depredations in the grainfields were of little moment. The district from Lake Cuitzeo to Patzcuaro has a cool climate, with abundant rains during the summer months. Tula lies in a much more arid and warmer zone."

PLATYGEOMYS PLANICEPS sp. nov.

(Pl. 13, fig. 3; pl. 14, fig. 9.)

?*Ascomys mexicanus*, Licht., Brants Muizen, 1827, 27-31 (in part).

Type from north slope VOLCAN TOLUCA, MEXICO. No. 55906 ♂ U. S. National Museum, Department of Agriculture, collection. Collected September 12, 1893, by E. W. Nelson. (Original No. 5466.)

Geographic distribution.—Northern and eastern slopes of the volcano of Toluca and adjacent part of the valley to the city of Toluca, from an altitude of 8,600 feet up to the vicinity of timber line.

General characters.—Similar to *P. tylorhinus*, from which it differs inappreciably in external appearance except in the greater length of the tail. Upper incisors unisulcate; skull broad and flat; size large; tail nearly naked; a naked pad on end of nose; forefeet with claws shorter than hind.

Color.—Upper parts chestnut, as in *tylorhinus* from Tula; under parts similar but paler, the plumbeous basal fur showing through in places; legs and ankles concolor with body; hairs of hind feet whitish, but scant. Nose below eyes blackish; a large blackish spot around each ear. One specimen is dark plumbeous, washed with chestnut, and has the head markings described under the Patzcuaro specimens of *tylorhinus*.

Cranial characters.—Skull similar to that of *tylorhinus*, from which it differs chiefly in the form of the jugal bone, which is narrow throughout or very slightly expanded anteriorly—not broadly expanded as in *tylorhinus*. It differs further from *tylorhinus* in having the nasals less squarely truncate posteriorly (and ending about on plane of middle of maxillary root of zygoma); the ascending branches of premaxilla rounded posteriorly and ending near anterior plane of orbits—not passing nasals so far as in *tylorhinus;* the cranium very broad and flat; occipital plane more than two and a half times as broad as high. The rostrum is narrow, but not narrower than in some specimens of *tylorhinus* from Tula.

Measurements (taken in flesh).—Type specimen ♂ : Total length, 372; tail vertebræ, 121; hind foot, 46. Average of two females from type locality: Total length, 336.5; tail vertebræ, 100; hind foot, 43.

For cranial measurements see Table E, p. 212.

Specimens examined.—Three, all from the north slope of the Volcan de Toluca, State of Mexico.

General remarks.—This animal may prove to intergrade with *tylorhinus* of Tula, in which case it must be reduced to subspecific rank. The number of specimens at hand (only three) is not sufficient to determine the constancy of the characters that distinguish it from *tylorhinus*. The chief differences, as above stated, are the longer tail and narrower jugal. The jugal is always narrower in females than in males, and two of the three specimens are females. The male (type specimen), while full grown, is not old, and its jugal may be abnormally slender, though there is nothing about the skull to suggest this belief. In the light of the present material no course seems open but to recognize the animal as a distinct species. It may be remarked, however, that it is the poorest species described in the present paper.

Respecting its local distribution Mr. Nelson states: "On the slopes of the Volcano of Toluca this species is not very numerous, but is found scattered in small numbers continuously from the base of the mountain up to the vicinity of timber line, usually in open parts of the pine forest and in small grassy parks. It is more common in the valley of Toluca, where it inhabits fields and grassy meadows and is very destructive to crops."

PLATYGEOMYS FUMOSUS Merriam.

(Pl. 11, fig. 4, and pl. 14, fig. 8.)

Geomys fumosus Merriam, Proc. Biol. Soc. Washington, VII, September 29, 1892, 165-166

Type locality.—Colima City, Mexico. (Type in U. S. National Museum.)

Geographic distribution.—Plain of Colima, Mexico. (Altitude 1,500 to 2,000 feet.)

General characters.—Size medium, about equalling *Geomys bursarius* (smaller than the other species of *Platygeomys*); pelage rather soft, sparingly mixed with long whitish bristles, which are most abundant on the rump; tail and hind feet nearly naked; nasal pad not strongly developed; color very dark.

Color.—Upper parts everywhere plumbeous slate or dark sooty brown, faintly washed in places, particularly along the sides, with pale reddish-brown; color of upper parts fading in worn pelage to pale dull liver brown, usually in irregular patches; underparts scant haired, pale plumbeous, sometimes indistinctly washed with pale brownish. A young specimen, about half grown (No. 34186 ♂), is rich slate black above, conspicuously lined with whitish bristly hairs, which are most abundant on the rump, and more so on the sides than along the middle of the back. There is also a faint brownish tinge on the sides of the neck. The scant hairs of the belly are very pale plumbeous or even soiled whitish.

Cranial characters.—Skulls of *Platygeomys fumosus* agree with those of the other members of the *gymnurus* group in the extreme breadth of the hinder part of the cranium, due to the expansion of the squamosals beyond the parieties of the brain case, and in the great lateral production of the angle of the mandible. *P. fumosus* departs from the *gymnurus* series markedly in the form of the zygomatic arches, which, when looked at from above, are rounded instead of sharply angular anteriorly, and have the sides nearly parallel or bowed outward, so that they are broadest across the middle instead of anteriorly. In *gymnurus* they are usually widely divergent anteriorly. *P. fumosus* differs further from the other members of the *gymnurus* series in greater interorbital breadth of frontals; strongly wedge-shaped nasals; more elongated postpalatal pits (which reach the plane of front of last molars), and in having the anterior end of jugal more deeply embedded between the terminal forks of the maxillary arm of the zygoma.

The jugals are but slightly (sometimes not at all) expanded anteriorly, in which respect the species agrees with *P. planiceps*, from the Volcano of Toluca. It differs from the latter greatly in the extent to which the jugal enters into the formation of the zygomatic arch; the jugal being so far overlapped by the maxillary and squamosal roots of the arch that its free upper border is short—less than half the length of the basioccipital in median line. It differs from *planiceps* further in broader rostrum, less spreading and more strongly decurved zygomata, and shorter and broader ascending arms of the premaxilla, which are bluntly rounded off opposite the middle of the maxillary root of the zygoma.

Measurements.—Average of seven males from type locality: Total length, 287.5; tail vertebræ, 82.2; hind foot, 42. Average of three females from type locality: Total length, 277; tail vertebræ, 75.3; hind foot, 39.6.

For cranial measurements see Table E, p. 213.

Specimens examined.—Total number, eleven; all from Colima City, Colima, Mexico.

General remarks.—*Platygeomys fumosus* belongs to the *gymnurus* series, of which it is the smallest species yet described. It differs markedly from the other members of the series in having the zygomatic arches rounded and nearly parallel instead of sharply angular and strongly diverging anteriorly; and differs further in having the sides and rump beset with whitish bristles that protrude far beyond the fur.

The original description of this species was faulty in several respects and is here corrected. The material collected by Mr. Nelson since the original description was published has thrown a flood of light not only on the affinities of this species but also on the whole group. It is now clear that *fumosus* is not related in any way to *hispidus*, authentic skulls of which are now available for the first time.

Mr. Nelson found this species limited in distribution. His notes state that it was rather numerous in damp saline flats overgrown with cocoanut palms, wild fig trees, mesquites, and acacias, in the valley of the Colima River near the city of Colima. In the vicinity of Armeria, at an altitude of about 200 feet, a few hills were seen but none of the animals were caught. Thence up the course of the Armeria river, on the plain of Colima the hills became more and more numerous, especially between the altitudes of 800 and 2,500 feet. The animals seem to live in isolated and limited colonies, between which, in apparently equally favorable ground they occur singly and rarely. One colony of considerable size occupies an open grassy area in the limestone belt between Colima and the volcano; others were seen along the sandy border of the Armeria river bottom in a growth of low bushes, and in some thick thorny woods on a dry bench bordering the Colima river a few miles below the city.

covering the posterior half of the inner side of the tooth, leavi
cement band in front of it (fig. 34, [7], [8], and [9]). In *O. scalops*
plate is often divided, presenting an anomalous condition in
(fig. 62). Posterior curvature of m^1 and m^2 and anterior cu
m_1 and m_2 strongly developed. Shaft of upper pm straight.

Upper incisor *unisulcate*, the sulcus widely open and slightl
side, but sometimes reaching middle.

FIG. 60.—*Orthogeomys scalops*. Longitudinal vertical median section of skull, mesethmo
in place. (For key see fig. 7.)

Skull as a whole much elongated; frontal extraordinarily broad and flat, much broader than muzzle, with sides nearly parallel (not excavated or concave laterally between the orbits, fig. 17[4]); orbital plates of frontal not meeting inferiorly behind cribriform, but broadly separated by orbitosphenoids, as in *Pappogeomys* and *Thomomys*. Zygomata narrow or only moderately spreading. Brain case subcylindric, as seen from above, in continuation of the general form of the frontal and muzzle. Angle of mandible short. Orbitosphenoids rather large, articulating with the anterior part of the alisphenoids and sending a tongue upward, partly filling the upper part of the sphenoidal fissure (fig. 60). Mesethmoid a half crescent, as in *Cratogeomys;* endoturbinals as a whole quadrangular, the anterior border essentially parallel to cribriform plate; first endoturbinal only slightly expanded and rounded anteriorly, as in *Geomys;* third endoturbinal larger and much broader than second—a unique condition in the family (fig. 61). The palatopterygoids are long and narrow, and of nearly equal breadth throughout; the basal third or less, is palatine; the distal two-thirds or more, pterygoid. The foramen rotundum and foramen ovale are nearer together than usual, and sometimes merge into a single large opening which communicates directly with the alisphenoid canal.

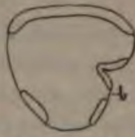

FIG. 62.—*Orthogeomys scalops*. Last upper molar. *b*, divided outer enamel plate.

External characters.—Size large; pelage very coarse, hispid or setose; nasal pad present or absent.

Cranial characters.—The chief cranial characters that distinguish *Orthogeomys* from the other genera having essentially the same enamel pattern of the molariform series (*Heterogeomys* and *Macrogeomys*)* are the great breadth of the frontal interorbitally, absence of interorbital constriction, absence of conspicuous postorbital prominences or ridges, large size and extended relations of orbitosphenoids, peculiar form of endoturbinals, and shape of the palatopterygoids. The great length and narrowness of the cranium as a whole is matched by *Macrogeomys dolichocephalus*, but the nearly uniform breadth of the upper part of the skull and the form of the zygomata and palatopterygoids are very different. The posterior position of the lateral enamel plates of m^3, both of which normally reach the end of the heel, is a distinctive character.

KEY TO SPECIES OF ORTHOGEOMYS.

Pelage setose; muzzle short .... *latifrons*.
Pelage not setose; muzzle long:
  Frontal inflated on orbital margin anteriorly; m^3 normal—
    Nasals broad posteriorly .... *grandis*.
    Nasals narrow posteriorly .... *nelsoni*.
  Frontal inflation slight or absent; m^3 with outer enamel plate divided .. *scalops*

*It has been stated in the preceding footnote that the upper premolar of *Orthogeomys* normally has only three enamel plates, while in *Heterogeomys* and *Macrogeomys* four are always present. Hence the enamel pattern can hardly be said to be the same.

ORTHOGEOMYS SCALOPS (Thomas).

(Pl. 19, figs. 1 and 2, and text figs. 60–62.)

Geomys scalops Thomas, Annals and Mag. Nat. Hist., 6th series, XIII, May, 1894, 437–438.

Type from TEHUANTEPEC, MEXICO. (Type in British Museum).

Geographic distribution.—Extreme southern Mexico, in State of Oaxaca, and probably adjacent part of Chiapas.

Mr. Nelson states that on the pine-covered slopes of the Cerro San Felipe, a few miles north of the city of Oaxaca, he found the diggings of this gopher extending upward from an altitude of about 7,000 feet to the summit (altitude about 10,500 feet), always in pine or oak timber or in the small openings that occur in the forest.

General characters.—Size rather large; pelage hispid; naked nasal pad large (measuring 20 mm. in length in fresh specimen); tail naked; hind feet naked, except for a few scattered colorless hairs; ear opening surrounded by a broad, thickened rim.

Color.—Type specimen in worn, faded pelage: "Smoky-brown, tending rather toward rufous (very near 'Prout's brown' of Ridgway)."—Thomas. An adult specimen from Cerro San Felipe, Oaxaca, collected June 21, 1894, by E. W. Nelson, is in good pelage and is dark seal-brown (almost black in places) with an evident gloss.

Cranial characters.—Skull of adult ♀ very long and narrow; frontal very broad interorbitally, not constricted in front of postorbital processes; zygomata little spreading, flattened, elongated antero-posteriorly, the outer sides parallel; occipital plane sloping forward; paroccipital flanges turned backward, but not reaching plane of occipital condyles; palatopterygoids narrow, of nearly uniform breadth throughout, the pterygoids forming distal two-thirds, but not reaching base of notch (see pl. 19, fig. 2). Inferiorly the premaxilla reaches far behind the incisive foramina. Contrasted with *latifrons*, which it greatly resembles, *scalops* differs in having the rostrum much longer, the nasals broader, more arched anteriorly, and longer, and the jugal broader anteriorly. The resemblances and differences are such as to at once suggest sexual variation—the skull of *O. latifrons* differing from that of *scalops* in the way that female skulls usually differ from males in the *Geomyidæ*—smaller size, shorter rostrum, and narrower jugals. But, unfortunately for this hypothesis, the specimen of *scalops* is an adult female, as shown both by the collector's label and by the conspicuous teats on the dry skin. Furthermore, the grooving of the upper incisors is very different and the external characters are marked.

Since the above was written I have received nine additional specimens of *O. scalops* from Mr. Nelson, all collected in the Cerro San Felipe, near the city of Oaxaca, during the last week of August and 1st of September, 1894. Two of these are adult males. Their skulls differ from those of the female in slightly larger size; more spreading and somewhat heavier zygomata, which divaricate anteriorly instead of being parallel; in a more decided tendency to inflation of the anterior part of the border of the frontal; the development of a long sagittal ridge, and of much larger paroccipital processes, which reach backward behind the plane of the condyles.

Male skulls of *scalops* from Cerro San Felipe, Oaxaca, differ from males of *nelsoni* from Totontepec and Mount Zempoaltepec, Oaxaca in the following characters: Size smaller, muzzle much narrower, the narrowness especially marked in the ascending branches of the premaxilla; nasals decidedly broader posteriorly and less evenly acuminate, spreading more abruptly in front of the middle; zygomatic arches more slender and more divergent anteriorly; frontal inflation less pronounced; paroccipital processes much larger and directed more strongly backward, exceeding the plane of the condyles; occipital plane less flattened, and marked by three ridges, a median ridge and two lateral; palatopterygoids shorter; groove of upper incisors narrower.

Dental characters.—Molars as in the genus. Upper incisors with a single deep and rather broad furrow wholly on inner side; outer side strongly convex. In *latifrons* the groove is relatively shallow and median, or nearly so. The outer enamel plate of the last upper molar is usually divided, making four instead of three plates for this tooth, a condition not observed elsewhere in the family (fig. 62).

Measurements.—Type specimen (measured by Thomas from dry skin): Head and body, 270; tail, 95; hind foot, 45.2 (without claw, 40).

Average of two males from Cerro San Felipe, Oaxaca (measured in flesh): Total length, 369; tail vertebræ, 103.5; hind foot, 50.*

Average of eight females from same place: Total length, 360; tail vertebræ, 109; hind foot, 50.

Cranial measurements.—Type specimen (measured by Thomas): Basal length, 63; basilar length of Hensel, 56.7; greatest zygomatic breadth, 40.8; nasals, length 26, greatest breadth, 8; least breadth of muzzle above maxillo-premaxillary suture, 15; interorbital breadth, 14.2; between tips of postorbital processes, 16.2; postglenoid breadth, 26.7; greatest squamosal breadth, 39; basion to occipital crest, 18.4; between tips of paroccipital processes, 27.5; palate from gnathion, 47; diastema, 24.5. Upper molar series on crowns, 12.6; breadth of m^1, 4; least height of muzzle on diastema, 12.

For other cranial measurements see Table F, p. 214.

Specimens examined.—Total number 13: 10 from Cerro San Felipe, Oaxaca, Mexico; 3 from mountains 15 miles west of city of Oaxaca.

General remarks.—*Orthogeomys scalops* seems to be more closely related to *O. grandis* than to *O. nelsoni.*

ORTHOGEOMYS GRANDIS (Thomas).

(Text fig. 63.)

Geomys grandis Thomas, Annals and Magazine Nat. Hist., 6 ser., XII, October, 1893, pp. 270-271.

Type locality.—DUEÑAS GUATEMALA. (Type in British Museum).

*A larger series of males would undoubtedly result in larger average measurements, as neither of our specimens are very old.

Geographic distribution.—"Common all over the highlands [of Guatemala], and traces of their presence are to be met with almost everywhere in the neighborhood of Dueñas."—Biologia Centrali-Americana, Mammalia, 1880, 160.

General characters.—Size very large; upper incisors deeply unisulcate, the sulcus on inner side and widely open; tail naked; fore and hind feet "very thinly haired, the few scattered bristles whitish;" pelage coarse. The following quotation is from Mr. Thomas's description of the type specimen:

Color.—"Smoky chocolate brown throughout, except on the muzzle, cheeks, and chin, where the hairs are white or pale whitish brown. A few white hairs scattered over the back."

Cranial characters.—"Skull large and heavily built. Ascending processes of premaxillaries surpassing the nasals by about a quarter of an inch; the space between them behind the nasals less than the breadth of one of them. Interorbital space broad, as broad as the muzzle, its edges anteriorly rounded and inflated in a manner quite unique. Zygomata not very widely expanded in proportion to the size of the skull.

"Incisors pale yellow or whitish, in marked contrast to the deep orange found in the allied species. Their single groove deep and very widely open, so that its greatest width on the cutting edge amounts to 2 mm.; in position the bottom of the groove is internal, the breadth of the inner portion of the tooth being about 43 to 45 percent of the whole; owing, however, to the great breadth of the groove itself, it considerably overlaps the median line, but the above percentage is taken strictly from the bottom of the groove. Molar teeth large."*

Measurements of type specimen (from dry skin).—Head and body, 320; tail, 135; hind foot, with claw, 57; without claw, 50; longest foreclaw, 23.

For cranial measurements see Table F, (p. 214).

General remarks.—This animal, though long known from Guatemala, had been confounded with *hispidus* until recently separated by Mr. Thomas, who, struck by its larger size and some other external differences, removed the skull from one of Mr. Salvin's original Dueñas specimens and discovered the remarkable cranial peculiarities above mentioned.

ORTHOGEOMYS NELSONI sp. nov.

(Text fig. 63.)

Type from MT. ZEMPOALTEPEC, OAXACA, MEXICO. (Altitude 8,000 feet.) No. [illegible] ♂ ad. U. S. National Museum, Department of Agriculture Collection. Collected July 8, 1894, by E. W. Nelson and E. A. Goldman. Original No. 6376.

Geographic distribution.—Mt. Zempoaltepec in the State of Oaxaca, Mexico, and the adjacent region, including Comaltepec and Totontepec.

General characters.—Size, largest of the known species of the family, slightly exceeding *O. grandis* of Guatemala, which it closely resembles, differing chiefly in the fronto-nasal region of the skull. Ears larger than in any other member of the family; naked nasal pad large; tail naked except at base.

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*Annals and Magazine Nat. Hist., XII, October, 1893, 270–271.

Color.—Uniform dull dark-brown; hardly paler below.

Cranial characters.—Skull large, 'ong, and heavy, resembling both *lops* and *grandis*, but differing from both in the shape of the nasal bones, which are *very much narrower posteriorly*. Mr. Oldfield Thomas has had the kindness to compare his type of *grandis* with the type and other skulls of *nelsoni* sent him for the purpose, and has taken the trouble to give me a sketch of the fronto-nasal region of *grandis*, with a number of detailed measurements which show the differences between the two forms. In addition to the striking narrowness of the nasals posteriorly, *nelsoni* differs from *grandis* further in the following points: the ascending arms of the premaxilla reach much further backward, cutting the plane of the orbit; the articular face of the maxillary root of the zygoma (on top of the skull) is much longer, measuring 11.5 instead of ... mm.; the frontal is both narrower and shorter between the nasal branches of the premaxilla; the muzzle is narrower, the frontal broader, and the frontal inflations are more anterior and less extreme. The mandible differs, not only from *grandis*, but from all known members of the family in the absence of the capsular inflation over the root of the incisor, between the condyle and angular process. It is entirely wanting in the type, and only faintly apparent in the adult female from the same locality. It is larger, but still abnormally small, in an old male from near *Totontepec* (No. 66753). The skull of the latter specimen is the largest I have seen of the species and the jugal is broader anteriorly than in the specimens from Mount Zempoaltepec.

Fig. 63.—*Orthogeomys nelsoni* ♂ type (natural size). From Mount Zempoaltepec, Oaxaca, Mexico.

Skulls of *O. nelsoni* differ from those of *O. scalops* in larger size, much broader muzzle, heavier zygomata, longer nasals, which are much narrower posteriorly and truly cuneate in form; much broader ascending branches of premaxilla; broader and decidedly more inflated frontal; U-shaped, instead of V-shaped postglenoid notch; flatter occipital plane, with less backward extension of the paroccipital processes.

Measurements.—Type specimen, an adult ♂ from Mount Zempoaltepec: total length, 397; tail, 123; hind foot, 53. Another male, from near Totontepec, is even larger: total length, 435; tail, 140; hind foot, ... An adult female from Mount Zempoaltepec measures: total length, ...; tail, 118; hind foot, 52.

For cranial measurements see Table F, p. 214.

Specimens examined.—Five, all from the State of Oaxaca, southern Mexico: Mount Zempoaltepec, 2; near Totontepec, 2; Comaltepec, 1.

General remarks.—In color the specimens of *O. nelsoni* differ materially from Mr. Thomas's description of *grandis*. They are in worn pelage, and are very dark-brown, but the muzzle and cheeks are not paler. In fresh pelage they would probably resemble *O. scalops* in being rich seal-brown, almost black. The feet are evidently more hairy than those of *grandis*, and the ears are larger than in any other member of the family, measuring about 5 mm. in height in the dry skin.

ORTHOGEOMYS LATIFRONS sp. nov.

(Pl. 11, figs. 5 and 6; text fig. 64.)

Type from GUATEMALA. Exact locality unknown. No. ——. U. S. National Museum (No. 2 World's Fair exhibit of Guatemala).

General characters.—Size medium (rather small for the tropical American species); incisor groove median or nearly so; tail long and absolutely naked; hind feet naked, except a few scattering hairs; fore feet scant haired; nasal pad small or absent; pelage hispid, scant and unusually long, unlike any known species of the family. The individual hairs are bristles, very much coarser and longer than those of *Geomys hispidus*. There is no under fur. The belly is so sparsely haired that the bare skin shows through.

Color.—Everywhere uniform dull sooty-brown.

Cranial characters—Unfortunately the skull of the type and only known specimen of this remarkable animal is defective, the entire occipital region and the audital bullæ being absent. The anterior part of the skull is perfect, including all of the teeth and one of the zygomatic arches. The upper surface of the cranium is remarkably smooth and free from lateral indentations or projections, and is of almost uniform breadth. Seen from above, the muzzle, frontal, and brain case pass into one another without interruption or constriction, the frontal being a trifle wider than the muzzle and the cylindrical brain case a trifle broader than the frontal. There is only a faint attempt at a postorbital prominence, and it is below the level of the top of the skull and is made up of the alisphenoid and squamosal. The muzzle is short. The zygomata are narrow and slender, without any enlargement or expansion at any point; they are broader posteriorly than anteriorly, and the maxillary arm slopes strongly backward. The jugal is small and slender and the arch is incomplete without it. The palatopterygoids are broken off. The ascending branches of the premaxilla slightly surpass the plane of the orbits. Inferiorly the premaxilla slightly passes the posterior end of the incisive foramina. The nasals are small, short, and narrow, but slightly broader anteriorly than posteriorly, and without trace of inflation. The angles of the mandible are short and flat. Unfortunately the palatopterygoids and audital bullæ are broken off, along with the whole of the occipital region, hence additional important characters may exist that are not apparent in the single specimen at hand.

Dental characters.—The single groove of the upper incisors is median, open, and rather shallow, and the face of the tooth slopes toward it from both sides. It thus differs widely from the deep and abrupt groove of *G. scalops*, which is wholly on the inner side. The face of the incisors is orange; in *scalops* it is pale yellowish or straw-color. The long axes of the crowns of the individual molars are not quite transverse, but slope slightly backward toward the median line. In most species they slope forward. The heel of the last upper molar is short, but is sharply circumscribed. In addition to the usual deep sulcus on the outer side, the inner side is abruptly narrowed (figs. 34[7] and 64). The enamel plates are peculiar: *Inner enamel plate covering considerably more than half of inner side of tooth, its anterior end bent outward at nearly a right angle; its posterior end curved toward the median line and reaching the hindermost part of the heel; outer enamel plate covering* about five-sixths of the outer side of the tooth, its anterior third bent outward at right angles, its posterior half sloping strongly backward to the end of the heel, forming nearly a right angle with the middle part and thus making two sharp angles instead of one—a unique condition. The posterior interspace is very narrow and is on the median line of the tooth behind. The inner interspace is twice as broad as the posterior.

a

b

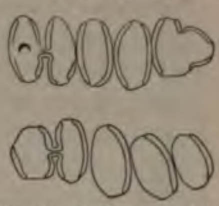

FIG. 64.—*Orthogeomys latifrons* (type). Crowns of molariform teeth: *a* upper; *b* lower.

Measurements (from dry skin, not overstuffed).—Total length, 320; head and body, 235; tail, 100; hind foot with claw, 44; hind foot without claw, 39.

General remarks.—Externally *Orthogeomys latifrons* may be distinguished from all other known members of the *Geomyidæ* by the character of the pelage, which is setose, the individual hairs being long bristles. In cranial characters it closely resembles *O. scalops*, but differs in the much shorter muzzle and nasals (which latter are not at all inflated anteriorly), and narrower jugal. The upper incisors are very unlike. In *latifrons* the face is orange, the groove median, or nearly median, and relatively shallow, and both sides slope similarly into it. In *scalops* the face is pale yellowish or straw color, the groove wholly on the inner side and deep and abrupt, and the outer side is strongly (roundly) convex.

Genus HETEROGEOMYS* nob.

(Pl. 4; pl. 14, fig. 12; pl. 15, fig. 2; pl. 17, fig. 1; pl. 18, fig. 3; pl. 19, fig. 5; text figs. 65 and 66; map 3[4].)

Type Geomys hispidus LeConte, from near JALAPA, VERA CRUZ, MEXICO.

Dental characters.—Upper premolar with four enamel plates, the posterior restricted to inner or lingual half. Upper and lower premolars

* *Heterogeomys*, from ἕτερος, different, + *Geomys*.

Posterior curvature of m^1 and m^2 and anterior curvature of slight. Shaft of upper pm straight or faintly convex forwa incisor unisulcate, the sulcus wholly on inner side of media sometimes on inner third; deep and abrupt (fig. 20^7).

Cranial characters.—Skull as a whole high and narrow; fr and flat; its sides biconcave interorbitally; distance betw much greater than length of basioccipital on median line impressions anteriorly defining a marked frontal shield orbital plate of frontal usually perforated by a foramen abo sphenoidal fissure; zygomatic arches variable, outer sid parallel, antero-external angle sharp and moderately expa rior surface of palatopterygoids cuneate-lingulate, long an the palatal arms much elongated, the pterygoid part sma minal; postpalatal pits deep; nasals much arched anteriorly the large nasal callosity; occipital plane but little more tha broad as high, very flat, sloping strongly forward from belo squamosal part very high above mastoid bullæ; orbitosphen shaped, rather narrow and long, not articulating with alis upper part of optic foramen disappearing in advanced life (pl endoturbinals peculiar, the first greatly expanded, its an vertical or slightly emarginate (pl. 19, fig. 5). Mesethm small and strongly convex anteriorly (pl. 18, fig. 3). Squam sion slight; fronto-maxillary suture reaching orbit in front mal (instead of behind, as usual). Mandible short and com lar processes short.

KEY TO SPECIES OF HETEROGEOMYS

HETEROGEOMYS HISPIDUS (LeConte).

(Pl. 4; text fig. 65; pl. 13, fig. 20; pl. 14, fig. 12; pl. 15, fig. 4.)

ys hispidus LeConte, Proc. Acad. Nat. Sci., Phila., V, September, 1852, 158.

ype locality.—Near Jalapa, Vera Cruz,* Mexico. (Type in Acad. Nat. nces, Phila.)

eographic distribution.—The 'Tierra Templada,' or middle belt, g the basal slope of the table-land, in the State of Vera Cruz, ico, between the altitudes of 4,000 and 4,500 feet. Mr. Nelson found species common about Jalapa and Jico, and in less abundance from the city of Orizaba north to Huatusco. The U. S. National um contains a specimen from Necostla (near Orizaba).

neral characters.—Size large; upper incisors deeply unisulcate, the s wholly on inner side; tail naked; a large naked pad on end of forefeet with claws shorter than hind; pelage harsh and stiff, e any other species known to occur in Mexico except *torridus.*

or.—Upper parts everywhere uniform dark seal-brown; † hardly below.

anial characters.—Skull as a whole high and narrow; frontal broad and flat, depressed and biconcave interorbitally, concave longitudinally and transversely; distance between orbits much er than length of basioccipital on median line; temporal impres- forming elevated semicircular ridges separated in both sexes by a ict interval, and extending from postorbital prominences to outer s of interparietal, anteriorly defining a marked frontal shield, and riorly inclosing a broad interparietal; zygomatic arches narrow, maxillary arms sloping strongly backward, outer sides nearly llel (sometimes broadest across the middle instead of anteriorly), o-external angle sharp and moderately expanded, but not in the l way; angle not produced downward; expansion oval in shape encroaching on orbital fossa, which is correspondingly narrowed his point; inferior surface of palatine bones greatly elongated pos- rly, forming, on either side of the postpalatal notch, narrow lingu- extensions which are terminated by short and narrow pterygoids; palatal pits deep; ascending branches of premaxilla broad and ntly rounded posteriorly; premaxilla extending far enough posteri- to inclose incisive foramina; nasals inflated anteriorly and then racted at nares; anterior nares larger than in the other groups; pital plane a little more than twice as broad as high, very flat (free

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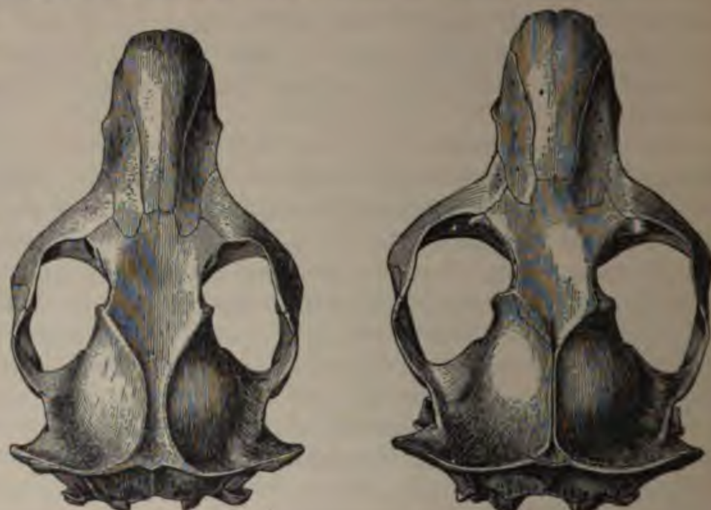
*The type specimen was collected by Mr. Pease in 1847 on the road followed by t's army "between Vera Cruz and the City of Mexico," which road passes through pa. Mr. Nelson found the species abundant about Jalapa, which is in the rra Templada,' about halfway down the slope from the table-land to the coastal . He ascertained further that the species does not occur on the table-land, h is inhabited by other genera.

†This color may be otherwise described as very dark plumbeous, faintly tinged purple.

from the projections and irregularities common to other forms), slopi strongly forward from below upward; brain case larger, more clea defined, and higher above posterior root of zygoma than in any otl group; squamosal expansion minimum, neither extending out far lat ally nor increasing length of glenoid fossa anteriorly—the usual sh like projection into the orbito-temporal fossa from the posterior root the zygoma being nearly obsolete; fronto-maxillary suture reachi orbit in front of lachrymal (instead of behind it as usual). This arrang ment broadens the frontal anteriorly, shortening and apparently wea ening the attachment of the maxillary root of the zygoma. Mandib short and compact, little spreading posteriorly; angular process shor prominence over root of incisor low and flattened posteriorly; condyla process long and only slightly sloping inward.



(65.) (66.)

FIG. 65.—*Heterogeomys hispidus.* Jico, Vera Cruz, Mexico. (Nat. size.)
FIG. 66.—*Heterogeomys torridus.* Motzorongo, Vera Cruz, Mexico. (Nat. size.)

Dental characters.—Front face of incisors perfectly flat, not rounde off on edges as in *Geomys*, *Platygeomys*, and *Zygogeomys*. Uppe incisors deeply unisulcate, the groove narrow and wholly on inne side. Lower incisors without bevel or groove on outer face. Molar larger, heavier, and less flattened antero-posteriorly than in *Geomy* or *Zygogeomys;* crown of last upper molar elongated posteriorly an abruptly narrowed behind lateral sulcus, the crown of posterior pris longer than anterior, to which it forms a distinct heel. Isthmus con necting anterior and posterior lobes of upper premolar decidedly o inner side of tooth.

Measurements (taken in flesh).—Average of two males from near typ locality (Jico, 7 miles south of Jalapa, Vera Cruz): Total length, 34 l vertebræ, 92.5; hind foot, 53. Average of three females from same ace: Total length, 310.6; tail vertebræ, 85.3; hind foot, 47.3.*

For cranial measurements see Table F, p. 215.

Specimens examined.—Total number 9, from the following localities the State of Vera Cruz, Mexico: Jico, 6; Huatusco, 1; Necostla, 1; cality unknown, 1.

General remarks.—Through the courtesy of Mr. Witmer Stone and her officers of the Academy of Natural Sciences of Philadelphia, the pe specimen of *Geomys hispidus* has been sent me for examination. n size, character of pelage, and all other respects except color, it grees almost exactly with Mr. Nelson's specimens. The color, which eConte described as "reddish-brown" and Baird as "reddish-brown or ull chestnut," was probably the result of museum exposure, the skin ing mounted and exposed to the light. It was collected by Mr. Pease 1847, during the march of Scott's army from Vera Cruz to the City of exico, and consequently had been in the collection five years before was described by LeConte. The fading has continued, the specimen w being much paler than when seen by Baird in 1855.

In view of the large number of species of Pocket Gophers now known inhabit southern Mexico, it is exceedingly gratifying to be able to tle the status of *hispidus* by actual comparison of the type specimen th the series collected by Mr. Nelson at or very near the original type ality. The skull of the type specimen has never been removed, and e cranial characters of the species have remained unrecorded until e present time. The series of skulls obtained by Mr. Nelson there- re were examined with unusual interest and the result was a complete rprise. They show not only that the animal is a strongly marked ecies, but that it is generically distinct from *Geomys*, as already inted out.

The naked nasal pad is more largely developed in this species than any of the others, and its large size is clearly correlated with the lated nasal bones. For this reason it shows to unusual advantage the type specimen, which is mounted with the skull inside, the arched sals keeping it stretched in its natural relations. In this specimen measures 12.5 mm. in length by 10 in breadth.

Mr. Nelson states that *H. hispidus* is confined to the district suitable to e cultivation of coffee and sugar cane and is said to be very injurious cane plantations.

HETEROGEOMYS TORRIDUS sp. nov.

(Pl. 15, fig. 2; pl. 17, fig. 1; pl. 18, fig. 3; pl. 19, fig. 5; text fig., 66.)

pe from CHICHICAXTLE, VERA CRUZ. No. 63629 ♀ ad., U. S. National Museum, Department of Agriculture collection. Collected February 15, 1894, by E. W. Nelson. (Original number, 5850.)

Geographic distribution.—Lowlands of Vera Cruz, from Chichicaxtle

* The measurements of the feet of the mounted type specimen as taken by me now, rly half a century after its capture, are: Forefoot from basal pad to tip of longest w, 42.5; hind foot from heel to tip of longest claw, 45.5.

and Motzorongo to Catemaco, and thence into Guatemala; penetrating the interior to Reyes, Oaxaca, and Guatemala City, Guatemala.

Mr. Nelson first observed this species on the way from Mirador to the coast, from an altitude of about 1,500 feet near Santa Maria, down to the border of the sand hills along the coast at Antigua. The next point where it was noted was on the route from the city of Cordoba to the hacienda of Motzorongo. At an altitude of 800 feet at this latter place it was again found in abundance. The easternmost locality at which it was obtained by Mr. Nelson is Catemaco, in the district of Tuxtlas. He afterwards secured it at Reyes, in northern Oaxaca, at an altitude of 6,700 feet. The range of the species is strictly tropical.

General characters.—Similar to *H. hispidus*. Size large; tail naked; naked nasal pad large; hind feet nearly naked; fore feet scant haired.

Color.—Everywhere dark seal-brown, only slightly paler below; in worn pelage chocolate brown.

Cranial characters.—Skull large, heavy and rather broad, resembling that of *H. hispidus*, from which it differs in the following particulars: Pituitary fossa deeper and (usually?) perforate; zygomata much more squarely spreading anteriorly (the maxillary arm standing out at more nearly a right angle instead of sloping strongly backward); temporal impressions uniting posteriorly in old of both sexes, but not rising in a sagittal crest; audital bullæ smaller, narrower anteriorly, and not sending up a point or ridge toward hamular process of pterygoid; ascending arms of premaxilla averaging broader and shorter posteriorly. The skull of the male differs from that of the female in larger size and greater angularity. The zygomata reach out much further sideways, are much broader anteriorly than across the middle, and the outer angle stands out prominently (in the female it turns downward). The jugal is considerably larger and broader anteriorly in the male.

Measurements (taken in flesh).—Type specimen (♀ ad. from Chichicaxtle): Total length, 323; tail vertebræ, 88; hind foot, 52.

Average of four adult males from Motzorongo: Total length, 348; tail vertebræ, 96.5; hind foot, 49.2.

Average of ten adult females from Motzorongo: Total length, 317; tail vertebræ, 81.5; hind foot, 45.5. The ♀ from Reyes, Oaxaca, is decidedly larger, measuring: total length, 332; tail, 98; hind foot, 49.5.

The mounted specimen in the World's Fair exhibit from Guatemala, which is considerably overstuffed, now measures: Total length, 380; tail vertebræ, 85; hind foot, 46. It is a female.

For cranial measurements see Table F, p. 215.

Specimens examined.—Total number 27: 2 from Guatemala; 1 from Reyes, Oaxaca, and 24 from the following localities in Vera Cruz, Mexico: Chichicaxtle (type locality), 1; Motzorongo, 22; Catemaco, 1.

General remarks.—*Heterogeomys torridus* differs but little externally from true *hispidus*. Even in color the type specimen, which is in worn pelage, except on the head, is only a shade paler than specimens of *hispidus*

pidus in worn pelage. The differences in cranial characters, however, are marked and constant. Still it is quite possible that intergrades may be found in the exceedingly narrow belt separating the two forms. It should be observed that the type specimen has a hind foot 4 mm. longer than the largest female from Motzorongo, and that the skull, also, is larger. The type is a very old individual.

Two specimens of a *Heterogeomys* from Guatemala, belonging to the U. S. National Museum collection, are here referred to the present species. One of these, a young adult (No. $\frac{9019}{22560}$) was collected many years ago near Guatemala City by Dr. Van Patten; the other was recently presented to the Museum by the Guatemala Commissioners to the World's Fair. The exact locality where it was obtained is unknown. It is an old female, and the temporal impressions meet over the middle part of the sagittal suture (which is obliterated, as in all adults of the species). The specimen obtained by Dr. Van Patten (probably also a female) is younger, and the temporal impressions are still distant. The two Guatemala skulls differ from those from Vera Cruz in having the postorbital prominence obsolete or nearly so.

Mr. Nelson states that in Vera Cruz this species is one of the most injurious of the genus to the agriculturist. At Catemaco he found it in small numbers among the dry hills and plains on the western border of the lake, but in the forest on the eastern shore it swarms in countless numbers. At one point the ground was fairly honeycombed with their tunnels, so that he sank to the knee at nearly every step.

Hetergeomys torridus becomes sexually mature at a remarkably early age. Several of the young females were mothers, and one in particular, though hardly half grown, has long pendant teats that have evidently been nursed. This specimen (No. 63640) is still in the woolly pelage of the very young, and its skull, barely half the size of the adult, has not yet attained the mature form. The animal could hardly be more than three months old. Its measurements in the flesh are: Total length, 259; tail vertebræ, 71; hind foot, 43.

Genus MACROGEOMYS* nob.

(Pl. 5; pl. 11, figs. 2 and 3; pl. 13, figs. 18, 19, 22, and 23; pl. 14, figs. 3 and 10.)

Type Geomys heterodus Peters, from COSTA RICA.

Dental characters.—Upper premolar with four enamel plates, the posterior restricted to inner third; m^1 and m^2 with two enamel plates each. Last upper molar with an elongated heel and deep outer sulcus; inner emargination variable (slight in *heterodus;* deep in *dolichocephalus*); inner enamel plate covering half to two-thirds of inner side of the tooth, its posterior end nearly reaching hinder end of heel. *Outer enamel plate* variable, the posterior limb double the length of the anterior. In *M. heterodus* it covers half; in *dolichocephalus* and *costari-*

* *Macrogeomys*, from μακρὸς, large, great, + *Geomys*, in reference to the large size of the animals.

censis, three-fourths of the outer side of the tooth. The posterior loop or heel is greatly developed, attaining the maximum size known in the family (about half or more than half the length of the tooth and narrow, the constriction about half the breadth of the anterior prism).

Posterior curvature of m^1 and m^2 and anterior curvature of m_1 and m_2 strongly developed. Shaft of both upper and lower premolar strongly convex forward and very large and heavy.

Upper incisor *unisulcate*, the sulcus wholly on inner third of face, narrow and deep; face of tooth flat on both sides of sulcus (fig. 20[1], and pl. 15, fig. 8).

Cranial characters.—Frontal broad, flat, depressed or concave along the median line, deeply excavated laterally between the orbits, the notch immediately succeeded by a strongly developed postorbital process (much larger than in any other member of the family, fig. 17[7]). Palatopterygoids broad, short, and truncated posteriorly, the horizontal part composed almost wholly of the palatal, the pterygoid simply capping the end and abruptly upturned at right angles (fig. 11[5]). Nasals moderately convex, slightly or not inflated. Brain case rising high above posterior root of zygoma. Unfortunately there are no skulls of *Macrogeomys* in the Department collection; hence I have been unable to make sections to expose the mesethmoid and turbinals.

The lambdoid crest is straight or slightly convex posteriorly (not sinuous as in *Platygeomys*) and the occipital plane is flat and slopes strongly forward, as in *Heterogeomys*.

External characters.—Size large; naked nasal pad well developed; tail naked; pelage soft, almost silky, and with a tendency to become wavy; color pattern unique, bicolor: muzzle and sides of rump abruptly whitish; rest of upper parts dark chocolate or sepia in marked contrast. (The color pattern of the adult *M. costaricensis* and *cherriei* is unknown.)

General remarks.—*Macrogeomys* requires comparison with only two genera, *Heterogeomys* and *Orthogeomys*, from both of which it may be distinguished at a glance, whether viewed from above or below. The most striking points of difference are the remarkably short and broad palatopterygoids and the strongly developed postorbital processes.

KEY TO SPECIES OF MACROGEOMYS.

Audital bulla normal, outer side not flattened.
- Skull short and broad; zygomata divergent anteriorly .... *heterodus*.
- Skull long and narrow; zygomata parallel .... *dolichocephalus*.

Audital bulla peculiar, the outer side flattened and disk-shaped.
- Jugal normal, entering largely into zygoma .... *cherriei*.
- Jugal small, the zygoma complete above without it .... *costaricensis*.

MACROGEOMYS HETERODUS (Peters).

(Pl. 11, fig. 2; pl. 14, fig. 3).

Geomys heterodus Peters, Monatsber. K. Preuss. Akad. Wiss., Berlin (1864), 1865, 177. (Translation of original description appended to present article, p. 189.)

Type locality.—Costa Rica. Exact locality unknown.

Geographic distribution.—The Irazu range and perhaps other parts of Costa Rica.

General characters.—Size large; face of upper incisors deeply unisulcate, the sulcus narrow and wholly on inner side of median line; enamel face of incisors orange; naked nasal pad large; tail absolutely naked; hind feet naked, with a few stiff hairs about the toes; fore feet nearly naked (shorter than hind); pelage moderately coarse, but not hispid as in *G. hispidus*; no external ears. Coloration peculiar, the muzzle and sides, including sides of rump, being conspicuously paler than rest of upper parts.

Color.—Upper parts uniform sepia or hair brown; muzzle, under parts, and sides all round abruptly much paler, the pale color (a soiled gray) reaching higher on the sides of rump than elsewhere and including base of tail.

Cranial characters.—Skull large, heavy, and rather short; zygomata broadly spreading, their sides divergent anteriorly, maxillary arms sloping backward less strongly than in *dolichocephalus;* antero-external angle well marked, moderately expanded; jugal large and broad, its upper surface not covered by squamosal and maxillary arms; frontal broad and flat, concave along the median line between the orbits and deeply notched on the sides immediately in front of the large postorbital processes, which latter are capped by the apex of the alisphenoid and overlapped posteriorly by the anterior edge of the squamosal. Nasals broadly wedge-shaped and not inflated. The ascending branches of the premaxilla slightly exceed the plane of the orbits. Inferiorly the premaxilla reaches but does not inclose the posterior end of the incisive foramina. The zygomatic breadth is considerably greater than the greatest squamosal or mastoid breadth. The occipital plane is flat (except a vertical median ridge) and slopes moderately forward; the lambdoid crest is straight, slightly incurved near median line. The palatopterygoids are broadly U-shaped and shortly truncate posteriorly, the pterygoids abruptly upturned at right angles to the palatals. The basioccipital has the sides parallel for the anterior half and is broadly wedge-shaped posteriorly. Audital and mastoid bullæ normal. The enamel face of the upper incisors is flat, with the sulcus deep, rather narrow, and wholly on inner side. Traces of the fine inner sulcus may also be seen in the only specimen at hand. The heel of the last upper molar is narrow, much elongated, and slopes strongly outward.

Macrogeomys heterodus differs from *M. dolichocephalus*, the only known species with which it requires comparison, in the very different form of the skull as a whole, it being much shorter and broader, and in the following details: Jugal broadest anteriorly and not covered by squamosal and maxillary arms of zygoma; zygomata divergent anteriorly (instead of parallel); nasals shorter and not inflated; orbital borders of frontal not inflated anteriorly; muzzle and diastema much shorter; palatopterygoids less broad at base; occipital plane broader and lower;

mastoid bullæ narrower vertically. Mandible much shorter. Heel of last upper molar longer and narrower, the outer enamel plate reaching little more than halfway from sulcus to end of heel; in *dolichocephalus* it reaches all the way.

Measurements.—Peters recorded no measurements for his type specimen, but Dr. Matschie has kindly measured it for me and finds the total length 325 mm. He states that the tail is defective. The specimen in the U. S. National Museum, from the Irazu Mountains, which is the subject of the foregoing description (a well-made dry skin), affords the following measurements: Total length, 325; head and body, 280; tail, 65; hind foot with claw, 45; hind foot without claw, 41.

For cranial measurements see Table F, p. 215.

General remarks.—The only species known to me with which *heterodus* needs comparison is *dolichocephalus*, which agrees with it in the abrupt paleness of the muzzle and sides of the rump. But *heterodus* differs from *dolichocephalus* in having the entire under parts and lower sides of the same pale color as the muzzle and sides of the rump. It differs further (in the specimens at hand) in the tint of the upper parts, which is sepia or hair brown instead of chocolate brown, and in the cranial characters above pointed out.

Unfortunately, Peters's description of his *G. heterodus* from Costa Rica is brief and unaccompanied by measurements, cranial characters, or exact locality (see next page). That his animal is the same as *hispidus* of LeConte (from Vera Cruz), as assumed by Coues and Alston, is exceedingly improbable on geographic grounds (in view of the remarkably restricted ranges of all the tropical American species now known) and impossible in view of the wide difference in coloration. Peters described *heterodus* as *bicolor*, the upper parts "dark brown," the muzzle, rump, and underparts "brownish gray or white." *Hispidus* is *concolor* and uniformly dark. Fortunately the type of Peters's *heterodus* is extant. It is still in the Berlin Museum, and Dr. Paul Matschie of that museum has had the kindness to send me additional notes, accompanied by full cranial measurements, which suffice to place its identity beyond question.

Through the courtesy of Mr. F. W. True, Curator of Mammals in the United States National Museum, I have been able to examine several specimens of the *Geomyidæ* from Costa Rica and Guatemala. Among those from Costa Rica is one which agrees in every way with Peters's original description of *heterodus*, and also with the additional particulars concerning Peters's type specimen kindly furnished me by Dr. Matschie. This specimen was recently presented to the museum by the Costa Rica Government through its commissioners to the World's Columbian Exposition at Chicago in 1893. It consists of a well-prepared skin, from which Mr. True has kindly had the skull extracted. It is the only specimen of *heterodus* I have seen, and is the subject of the foregoing description. Mr. George K. Cherrie, of the Costa Rica

National Museum, in response to a letter of inquiry, contributes the following important statement respecting this specimen: "It is No. 313 of the collection of the 'Museo Nacional,' an adult male; was collected October 15, 1890, near Rancho Redondo, a point on the Irazu range between the volcanoes Irazu and Barba, at an altitude of about 1,400 meters. The specimen was purchased from a 'peon' and mounted by myself. October is the last month of the rainy season, and the month in which it rains hardest. I might also add that the species is abundant in the locality given above."

Peters's original description of *heterodus* is as follows: "Our museum has received through Dr. Hoffmann and Dr. v. Frantzius the skin with the perfect skull of a new species of *Geomys* from Costa Rica, whereby the geographical distribution of this genus in Central America is established. This species agrees best with *G. mexicanus* Licht. in size, proportion of the limbs, nakedness of the tail, and the nature of its hairy covering, which latter, however, appears to be somewhat shorter and stiffer. The color is dark brown except on the belly, rump, and muzzle, which are brownish gray or white. It is, however, readily distinguished by the position of the deep longitudinal groove of the upper incisors, which does not run along the middle but between the inner and middle thirds of the teeth, for which reason I propose to name the species *Geomys heterodus*." (Monatsber. K. Preuss. Akad. Wiss., Berlin, 1864, 177.)

Dr. Paul Matschie has kindly sent me the following cranial measurements of Peters's type specimen of *heterodus*, which is in the Berlin Museum (No. 2864):

Greatest basal length (condyle to front of premaxilla), 61; basal length (basion to gnathion), 58; basilar length of Hensel (basion to alveolus of incisor), 51.2; greatest breadth across squamosals, 38; least breadth between postglenoid notches, 27.5; least interorbital breadth, 11; breadth across postorbital processes, 15.25; height of cranium above palate, 24; height above basion, 17; length of upper molar series on alveoli, 14; length of diastema, 22.5; length of single mandible (condyle to front of jaw between incisors), 44; breadth across angular processes, 40; distance from condyle to end of angular process, 13; breadth of muzzle just in front of zygoma, 15.

MACROGEOMYS DOLICHOCEPHALUS sp. nov.

(Pl. 5; pl. 10, fig. 7; pl. 13, fig. 19.)

Type from San Jose, Costa Rica. No. [illegible] ♂ ad. Collected January, 1866, by José C. Zeledon.

Geographic distribution.—Vicinity of San Jose, Costa Rica. Range unknown.

General characters.—Size large. Animal similar to *M. heterodus;* face of upper incisors deeply unisulcate, the sulcus narrow and wholly on inner side of median line (pl. 15, fig. 8); enamel face of incisors orange;

naked nasal pad large;* tail absolutely naked; hind feet naked, with a few stiff hairs about the toes; fore feet nearly naked (shorter than hind); pelage moderately coarse, but not hispid as in *Heterogeomys hispidus*; no external ears. Coloration peculiar, the muzzle and sides of rump conspicuously paler than rest of upper parts, as in *heterodus*.

Color.—Upper parts dull chocolate brown, except muzzle and lower part of rump, which are buffy in conspicuous contrast, but without line of demarkation. (The buffy of the rump surrounds the base of the tail and reaches further anteriorly on the sides than along the middle of the back.) Under parts similar to back but paler, without line of demarkation; wrists and ankles pale. No dark patch around ears.

Cranial characters.—The skull of *Macrogeomys dolichocephalus*, in addition to the generic characters which associate it with *M. heterodus*, is remarkable for its length and narrowness, the zygomatic breadth in an old male (the type specimen) being only 58 percent of the total length (from condyle to point of premaxilla), and the greatest squamosal or mastoid breadth only 57 percent. The opposite extreme is found in the genus *Platygeomys*, in which the corresponding ratios in *P. gymnurus* are 71 and 75.

The zygomata are not only very narrow, but present the appearance of having been drawn out while in a plastic condition. The maxillary arms slope strongly backward and are broadly rounded off without trace of angle or of angular expansion at the usual place, though there is a slight expansion about the middle of the outer side of the arch, encroaching on the orbito-temporal fossa, which it constricts in the middle opposite the large postorbital processes—a step toward the differentiation of these two fossæ from one another. The jugal is broad, short anteriorly, narrower at both ends than in the middle and is overlapped by the maxillary and squamosal arms of the zygoma, which nearly or quite meet above it. The frontal is grooved medially between the orbits and is somewhat inflated along the margin of the orbits behind the lachrymal bones, in this respect resembling *O. grandis* of Thomas, though the inflation is much less extreme. The sides of the frontal are deeply notched immediately in front of the large postorbital processes. The nasals are wedge-shaped as in *heterodus*, but longer and slightly inflated anteriorly; they are broadest near junction of middle and anterior thirds (in the ♂ only). The ascending branches of the premaxilla barely reach the plane of the orbits. Inferiorly the premaxilla reaches the posterior end of, but does not inclose, the incisive foramina, as in *heterodus*. The zygomatic breadth is only a trifle greater than the mastoid breadth. The occipital plane is flat, high, and slopes strongly forward; the lambdoid crest is slightly convex posteriorly. The palatopterygoids are very broad and

*In an alcoholic specimen (No. 1466 U. S. National Museum) the nasal pad or callosity is broad and rather short, not reaching posteriorly behind plane of upper incisors.

short. [In the male skull the pterygoids are broken off; in the female they are abruptly upturned, as in *heterodus*.] The basioccipital has the sides parallel in the anterior half and is broadly wedge-shaped posteriorly. The height of the cranium above the palate is unusually great, and the zygomata do not descend below a plane drawn midway of the height of the skull. The audital bullæ are normal and rather short, plump, and well rounded anteriorly. The brain case seen from above is subcylindric in shape, in which respect it resembles *Orthogeomys*. The nasals end in front of the plane of the zygomatic arches, while the premaxillæ reach the plane of the orbits, causing an unusual elongation of the median part of the frontal in order to articulate with the nasals. The mandible is long and narrow. The enamel face of the upper incisors is flat, the sulcus deep, narrow, and wholly on inner side (fig. 20[1]).

A young female of *M. dolichocephalus* (No. 36820) differs from the old male above described (36295) in the following particulars: The skull as a whole is very much smaller (see table of cranial measurements); nasals very much shorter, flatter, and broadest anteriorly (instead of at junction of middle and anterior thirds); temporal impressions distant (interspace 3 to 4 mm broad); brain case less cylindrical (owing in part to greater depth of constriction running obliquely upward from posterior root of zygoma to occiput, and in part to a slight bulging upward of the middle of the brain case); basioccipital narrower. The top of the skull in profile is not a straight line, the brain case presenting a slight convexity behind the orbits, while the interparietal and occipital crest fall below the plane of the upper surface as a whole. In both sexes the anterior part of the nasals is strongly decurved.

M. dolichocephalus differs markedly from *M. heterodus*, the only species with which it requires comparison, in the general form of the cranium, which is narrow and greatly elongated; in the narrow, drawn-out zygomata, without trace of angular projection or expansion; in the narrower jugal, which is covered above by the anterior and posterior arms of the arch, which meet or nearly meet above it; in having the zygomata parallel (instead of divergent anteriorly); the nasals longer and somewhat inflated anteriorly; the muzzle and diastema much longer; the palatopterygoids broader at base; the occipital plane higher and less broad; the mastoid bullæ much higher vertically; and the mandible much longer.

Measurements (of type specimen, ♂ ad., from dry skin): Total length, about 380 (approximate, as the tail was not wired and is shrunken); head and body, 310; tail, about 75 (approximate only); hind foot, 48; without claw, 45.

Measurement of a young female from Costa Rica, preserved in alcohol (No. [illegible] ♀ yg. ad., U. S. National Museum, collected by José C. Zeledon and received in October, 1884): Total length, 310; tail, 74; hind foot, with claw, 49; without claw, 43; forefoot, with claw, 45; without claw, 33.

For cranial measurements see Table F, p. 215.

General remarks.—Externally *Macrogeomys dolichocephalus* resembles *M. heterodus* in the peculiar paleness of the muzzle and sides of the rump (in strong contrast to the color of the rest of the upper parts), but differs from *heterodus* in not having the lower part of the sides and belly of the same pale tint. On the other hand, the pale color of the rump reaches a little further forward on the dorsal surface. There is a slight difference also in the tint of the upper parts, the color being dull chocolate brown in *dolichocephalus*, while it is sepia or hair brown in *heterodus*. The important cranial differences have been pointed out.

The alcoholic specimen already mentioned (No. 14666) is a female, and although not fully adult, has borne young, as shown by the large pendent nipples. The teats are: pectoral $\frac{1}{1}$, inguinal $\frac{2}{2}=\frac{3}{3}$, as usual in the group. The pectoral pair are situated on the sides immediately behind the fore legs. The inguinal pairs are not *on* the belly at all, but on the *inner side of the thighs* just below and outside of the belly.

The great callosity at the hinder edge of the wrist is made up of two large tubercles resembling kernels of corn placed side by side and covered by common integument.

MACROGEOMYS COSTARICENSIS sp. nov.

(Pl. 11, fig. 3; pl. 13, fig. 23; pl. 14, fig. 10.)

Type from PACUARE, COSTA RICA. No. [illegible] juv. U. S. National Museum. Collected in 1876 by Juan Cooper. (Original No. 96.)

General characters.—Upper incisors with a single deep sulcus wholly on inner side; pelage in type specimen (immature) short and silky, suggesting the fine crinkled pelage of *Didelphis murina;* tail and hind feet naked; a conspicuous naked pad on end of nose.

Color.—Upper parts uniform dark-brown, *not* paler on nose and rump; underparts abruptly whitish. The type and only known specimen has a large symmetrical white spot on top of the head, occupying about three-fourths of the area bounded by the eyes and ears.*

Cranial characters (of immature skull, pl. 11, fig. 3).—Similar in a general way to an immature ♀ skull of *M. dolichocephalus* (No. 36820), from which it differs in the following particulars: Nasals very much broader throughout, particularly posteriorly; space between posterior ends of ascending arms of premaxilla about twice as broad; zygomata standing out more squarely, nearly at right angles to axis of skull, with anterior angle abruptly rounded; jugal narrower; palatopterygoids shorter and broader; basioccipital very much broader and wedge shaped, its inferior surface not excavated by audital bullæ; audital

*The white crown patch of *costaricensis* was at first believed to be abnormal, falling in the same category with the irregular white blotches frequently found on the throat and sometimes at the base of the tail, in various species of pocket gophers. But the fact that the spot is bilaterally symmetrical, and is repeated in the only specimen known of a closely allied species, *cherriei*, points to its permanence, at least as a mark of the young.

bulla peculiar, compressed, the outer side strongly flattened, more smoothly rounded, somewhat disk-shaped, and separated from the mastoid bulla inferiorly by a distinct groove. The only other known species of the family having a similar audital bulla is *Macrogeomys cherriei* of Allen. Both are known from single specimens only, and both are too young to show all of the characters of the adult. Their specific distinctness will be apparent at a glance at the accompanying cut (fig. 67) showing the differences in the jugals. The palatopterygoids also are different. The palatopterygoids of *M. costaricensis* are shown on pl. 14, fig. 10, but the figure is inaccurate; in the specimen they are shorter and broader, more nearly as in fig. 3 of the same plate. The pterygoids of *cherriei* are broken, but the remaining base shows that they are considerably more slender.

In *M. costaricensis* the jugal is much shorter than the basioccipital (measured from condyle) and is wholly inferior, the maxillary and squamosal roots of the zygoma meeting above it and on its inner side, so that when viewed from the inner side it appears only as a narrow edge with the apex upward (fig. 67, [4]). In position and relations, therefore, it resembles *Zygogeomys trichopus*, though considerably broader than in that species.

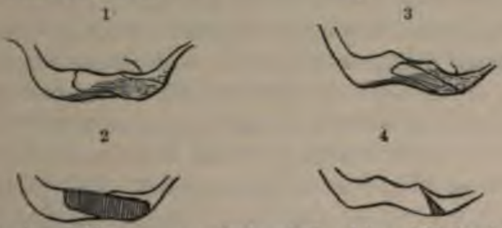


FIG. 67.—Zygomatic arches of *Macrogeomys costaricensis* (3 and 4), and *M. cherriei* (1 and 2). 1 and 3 outer side; 2 and 4 inner side.

Measurements.—Type specimen (probably not more than two-thirds grown) from dry skin: Total length, 330; tail (apparently stretched), 100 from point assumed to be over first caudal vertebra, 80 from apparent base; hind foot, 37 (without claw, 33).

For cranial measurements see Table F, p. 215.

General remarks.—This singular species, for the privilege of describing which I am indebted to the courtesy of Mr. F. W. True, Curator of Mammals in the U. S. National Museum, is represented in the collection by an immature specimen only. At first it was supposed to be the young of *M. dolichocephalus*, but comparison of its skull with that of *dolichocephalus* shows numerous points of specific difference, as above mentioned. While the peculiar texture of its pelage may be due in part to immaturity, this explanation fails when applied to the cranial characters which, as described above, are numerous and striking and of such a nature that most of them would be accentuated by age. In external appearance the animal bears a striking resemblance to the young type of *Macrogeomys cherriei*.

MACROGEOMYS CHERRIEI (Allen)

(Pl. 15, fig. 1.)

Geomys cherriei Allen, Bull. Am. Mus. Nat. Hist., V, 337–338, Dec. 16, 1893.

Type from SANTA CLARA, COSTA RICA. No. 664 ♂ im. Museo Nacional de Costa Rica. Collected in October, 1892, by George K. Cherrie.

General characters.—Naked nasal pad large; tail and hind feet naked. Similar to *Macrogeomys costaricensis* in size and coloration, including the white head patch, but differing in important cranial characters.

Color (of type, juv.).—Upper parts very dark plumbeous or sooty brown; under parts abruptly paler, with distinct line of demarkation; top of head between eyes and ears pure white.

Cranial characters (from skull of type, but little more than half grown, pl. 15, fig. 1).—The skull of *M. cherriei* agrees with *Heterogeomys hispidus* in general form, in the widely-separated temporal impressions; the broad and flat frontal, depressed between the orbits; the flat forward-sloping occipital plane; the form of the zygomata; the inflated nasals, and the short and compact under jaw, with short angular processes. But it is so young that one must be cautious in placing much stress on characters that vary with age. It differs from *H. hispidus* and agrees with *M. costaricensis* in the convexity of the anterior part of the roof of the brain case;* in the peculiarly flattened and smoothly rounded audital bullæ, which are separated from the mastoid bullæ by a distinct inferior transverse groove; and in the long heel of the last upper molar. It differs from *costaricensis* in the size, form, and relations of the jugal (as shown in fig. 67), in narrower palatopterygoid lingulæ, and in a narrower gap behind the nasals (between posterior ends of ascending branches of premaxilla). The jugal is large and long, and nearly half of its upper edge enters into the orbital fossa; it is not covered anteriorly by the maxillary arm of the zygoma, and its total length is greater than that of the basioccipital (measured from condyle). In *M. costaricensis* the jugal is much shorter than the basioccipital (measured from condyle), and is completely covered by the maxillary and squamosal arms of the zygoma, which meet above it (fig. 67). It differs further from *costaricensis* in the shape of the horizontal part of the zygomatic arch, which is not strongly convex upward, and lacks the constriction tending toward the separation of the orbital from the temporal fossa. The large orbito-temporal fossæ are broadest across the middle—just where they are narrowest in *costaricensis*.

Measurements.—Hind foot, with claws, 39 mm. (in dry skin). No measurements were recorded from the flesh, and the specimen is far from full grown.

For cranial measurements see Table F, p. 215.

General remarks.—Through the courtesy of Dr. J. A. Allen, Curator of Mammals in the American Museum of Natural History of New

* It is probable that the saddle-shaped frontal of *costaricensis* and *cherriei* is the result of immaturity, since a young skull of *G. trichopus* (No. 50104) shows the same peculiarity, though in less degree.

York, I have been able to examine the only specimen known of this species. It belongs to the Museo Nacional de Costa-Rica, and was loaned Dr. Allen by Mr. George K. Cherrie, who collected it at Santa Clara, Costa Rica, in October, 1892. It is a male, and, like the type of *costaricensis*, is immature. It resembles the latter in having a large pure-white patch on top of the head,* in the large size of the naked nasal pad or callosity, and in the nakedness of the tail and feet. The hind feet are absolutely naked; the forefeet are naked except for the presence of a few long hairs about the toes. The color of the upper parts is somewhat darker than in *costaricensis*. The specimen is so young that some hesitancy is felt in its generic assignment. It may be a *Heterogeomys* instead of a *Macrogeomys*, though this is exceedingly improbable.

Genus ZYGOGEOMYS† nob.

(Pl. 6; pl. 13, fig. 24; pl. 14, fig. 1; pl. 15, fig. 10; pl. 17, fig. 2; pl. 18, fig. 2; pl. 19, fig. 4.)

Type Zygogeomys trichopus sp. nov., from NAHUATZIN, MICHOACAN, MEXICO.

Generic characters.—Upper premolar with four enamel plates, the posterior restricted to lingual third; upper and lower premolars subequal in length; shaft of upper premolar slightly convex forward.

First and second upper molars with two enamel plates each, the posterior failing on outer side. Third upper molar an incomplete double prism; crown much longer than broad; heel well developed, broad, narrowed on outer side only; sulcus on middle of outer side; absent on inner side. *Inner enamel plate* covering two-thirds to three-fourths of inner side of tooth, straight, reaching end of heel posteriorly; *outer enamel plate* covering about half or a little less than half of outer side of tooth, its anterior half bent strongly outward. Interspaces broadly open, the posterior broadest, directed backward, and often forming a sort of everted lip (fig. 27^5).

Upper incisors bisulcate; principal sulcus on inner side of median line; minor sulcus on inner convexity (see fig. 22^1 and pl. 15, fig. 10).

Cranial characters.‡—Cranium as a whole long and narrow, the zygomata not widely spreading, slender, antero-external angle rounded and not expanded; zygomatic arch normally complete without jugal, the

* The white crown patch of *cherriei* and *costaricensis* was at first believed to be abnormal. But the fact that the spot is bilaterally symmetrical, and is repeated in the only specimen known of *Macrogeomys costaricensis*, which is likewise young, suggests its possible permanence, at least as a mark of immaturity.

† *Zygogeomys*, with reference to the unique character of the zygomata.

‡ Owing to the extreme difficulty of discriminating generic from specific characters in animals presenting such extraordinary cranial variations as the Mexican *Geomyidæ*, it is thought best in descriptions of genera, of which only a single species is known, to record all of the characters that seem entitled to more than specific weight. The generic diagnosis here given, therefore, errs on the side of fullness. The future discovery of additional species will promptly reduce the number of characters.

maxillary and squamosal arms coming in contact above it; jugal rudimentary, inferior and chiefly external; rostrum long and narrow; temporal impressions meeting in a short but well-developed sagittal crest; palatine bones contracted at base of pterygoids; pterygoids vertical lamellæ as in *Thomomys*, meeting or nearly meeting in median line behind palate. Premaxilla not inclosing incisive foramina, which is bordered posteriorly by the maxilla.

Mandible rather long and slender, much as in *Geomys bursarius*; orbitosphenoids relatively larger than in any other genus of the family, closing the upper part of the sphenoidal fissure (except a foramen at apex) and ankylosed broadly with the alisphenoid (pl. 17, fig. 2), as in some species of *Thomomys;* sphenoid fossæ correspondingly shortened, reaching only halfway from horizontal part of alisphenoid to base of cribriform plate; mesethmoid quadrangular, much longer than high (pl. 18, fig. 2); endoturbinals collectively subquadrate, but with antero-superior corner rather sharply elongated, projecting into posterior emargination of nasoturbinal; the os planum spreading forward in front of fourth endoturbinal about as far as length of latter (pl. 19, fig. 4).

General remarks.—*Zygogeomys* presents the unique combination of distinctly bisulcate incisors with remarkably short sphenoid fossæ and a type of zygomatic arch heretofore unknown in the whole order Rodentia. It presents further an exceptional degree of coossification of the component elements of the skull. The occipitals, parietals, frontal, ethmoid, squamosals, alisphenoids, maxilla, palatines, and pterygoids are ankylosed together; and the basisphenoid, presphenoid, and orbitosphenoids are ankylosed together. Furthermore, the two resulting complex masses are firmly united by ankylosis of the orbitosphenoids with the alisphenoids. The coossification is sometimes carried even further by the fusion of the anterior and posterior arms of the zygoma, and the union of the premaxilla with the maxilla and nasals. The sutures that remain open are between the basioccipital and basisphenoid; between the frontal on the one hand and the nasals, premaxillaries, and maxillary root of the zygoma on the other; between the maxilla and frontal anteriorly, and maxilla and alisphenoid posteriorly. The result of these extensive ankyloses is that in old age all of the bones of the cranium except the mandible are inseparably bound together—if not directly in every case, then in a roundabout manner. *Zygogeomys* thus occupies an anomalous position in the family.

ZYGOGEOMYS TRICHOPUS sp. nov.

(Pl. 6; pl. 13, fig. 24; pl. 14, fig. 1; pl. 15, fig. 10.)

Type from NAHUATZIN, MICHOACAN, MEXICO. No. 50107 ♂ ad., U. S. National Museum, Department of Agriculture collection. Collected October 11, 1892, by E. W. Nelson (original No. 3571).

Geographic distribution.—The Sierra Madre of Michoacan, from Patzcuaro to Nahuatzin; strictly limited to the pine zone, between the altitudes of 6,800 and 9,500 feet (map 3³).

General characters.—Size large; tail rather long, entirely naked from base; a conspicuous naked pad at end of nose; fore feet and claws shorter than hind; upper surfaces of both fore and hind feet densely covered with hair, completely hiding the skin; color very dark. Cranial characters marked; maxillary and squamosal arms of zygoma meeting above the jugal, which is greatly reduced.

Color.—Upper parts varying from dark slate to rich seal-brown, glossy, and finely mixed with a very thin wash of ferruginous, especially on the sides; underparts dark plumbeous washed with fulvous; upper surfaces of hind feet slate-gray, sometimes varying to white; an irregular patch of white on throat. Some specimens lack the ferruginous wash and are glossy slate-black. Some have an almost metallic luster.

*Cranial characters.**—Skull, as a whole, long and narrow; zygomatic arches contracted, slender, not expanded at antero-external angle; complete without jugal, which is much reduced in size, the maxillary and squamosal arms meeting above it†; rostrum and nasals long and narrow; temporal impressions meeting in a short but well-developed sagittal crest; palatine bones contracted at base of pterygoids; pterygoids vertical lamellæ as in *Thomomys;* occipital plane nearly vertical, about twice as broad as high; mastoid bullæ fuller and more rounded posteriorly than in *Geomys;* audital bullæ of moderate size, similar to those of *Geomys bursarius;* premaxilla ending below at middle of incisive foramina (instead of surrounding them, as usual in the family); postpalatal pits rather narrow, elongated and shallow, reaching anterior plane of last molar; mandible rather long and slender, much as in *Geomys bursarius;* angular processes moderate; condylar process rather short; coronoid process long, its tip overhanging front of condyle.

Measurements (taken in flesh).—Type specimen, ♂ ad.: Total length, 346; tail vertebræ, 115; hind foot, 46. Average of three adult males from type locality: Total length, 342.6; tail vertebræ, 111; hind foot, 45.8. Average of seven females from type locality: Total length, 322.7; tail vertebræ, 105.8; hind foot, 42.8.

For cranial measurements see Table C, p. 209.

Specimens examined.—Total number 12, from the following localities in Michoacan, Mexico: Nahuatzin, 10; Patzcuaro, 2.

General remarks.—Mr. Nelson found these remarkable animals pretty generally distributed over the wooded mountain slopes except where the timber is dense. They are most numerous about the borders of small grassy parks and in the more open parts of the forest. In places where the land has been cleared in these mountains they infest the culti-

* Owing to the circumstance that only a single species of this remarkable genus is known, it is unsafe to attempt to discriminate sharply between generic and specific characters. For this reason many of the characters given in the generic description are here repeated.

† In some specimens the union is not quite complete.

vated fields and do considerable damage to the corn, wheat, and potatoes of the Indian farmers.

Genus THOMOMYS Max Wied, 1839.

(Text figs. 31[5], 32[b], and 68-71.)

Type *Thomomys rufescens* Max Wied. Type locality unknown.

Thomomys Max Wied, Nova Acta Acad. Caes. Leop.-Carol. Vol. XIX, pt. 1., 1839, 377–384.

Upper and lower molars, including m^3, with two enamel plates each, one anterior and one posterior (figs. 31[5] and 32[b]). Upper incisor with sulcus normally very small and close to inner edge of tooth (fig. 23, p. 72), or absent. In a few species it is relatively large and deep, as in *T. monticola* of Allen.

Orbital plates of frontal not meeting inferiorly behind cribriform plate of ethmoid, but broadly separated by orbitosphenoids (fig. 71, *fro*).

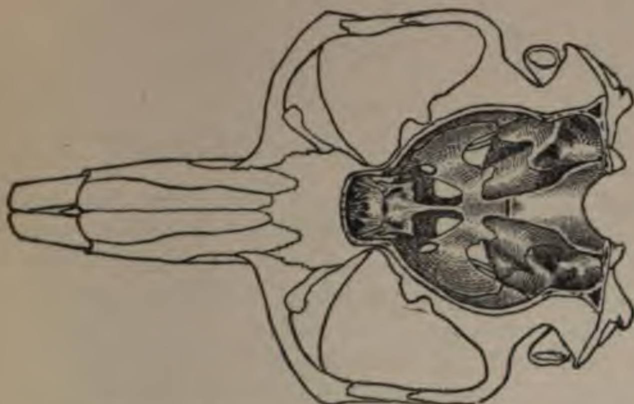
FIGS. 68-71.—*Thomomys bulbivorus*. ♀ Salem, Oregon.

68. Vertical longitudinal section of front of skull, showing turbinated bones. For key see fig. 18.

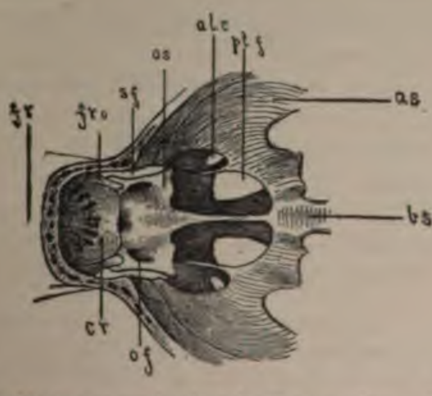
69. Vertical longitudinal median section of skull, mesethmoid and vomer in place. For key see fig. 7.

The accompanying cuts (figs. 68–71) show the relations of the several bones forming the floor of the brain case, and also those of the nasal chamber, in *Thomomys bulbivorus* of Richardson. In this species the incisors project much further forward than usual. The various species differ considerably in important cranial characters, as will be shown in a special paper on the species of *Thomomys*. The geographic distribution of the group as a whole is shown on map 1, A.

Externally *Thomomys* differs from all the other genera of the *Geo-yidæ* in the relatively small size of the fore feet. In this respect, and the faint sulcation of the incisors, the presence of two enamel plates each of the molars, above and below, and in numerous cranial char-ters it is much less highly specialized than most members of the mily.



70. *Thomomys bulbivorus*, from Salem, Oregon. Skull from above; vault of cranium sawed off to show or of brain case. For key see fig. 9.



. Anterior part of floor of brain case, much enlarged. (Same specimen as fig. 70.)
alc Anterior opening of alisphenoid canal.
as Alisphenoid bone.
bs Basisphenoid.
cr Cribriform plate of ethmoid.
fr Frontal.
fro Orbital or descending plate of frontal. It should be observed that this plate does not meet its fellow inferiorly behind the cribriform plate as in most of the other genera.
of Optic foramen.
os Orbitosphenoid.
ptf Pterygoid fossa.
sf Upper part of sphenoidal fissure.

APPENDIX.

(A.) Status of Geomys mexicanus Auct.

he earliest description that I have seen of any member of the ly *Geomyidæ* was published by Fernandez in 1651, and relates to exican animal called by him the Tucan or Indian mole.* Nearly a ury and a half later Kerr bestowed the name *Sorex mexicanus* upon nandez's Tucan without having seen a specimen (Kerr, Animal gdom, 1792, 207–208). It is not surprising that Kerr followed nandez and Buffon in placing the animal among the moles,† misled its projecting incisors and habit of throwing up little mounds of th along the course of its subterranean galleries.

he animal seems to have been first referred to the genus *Geomys* by Conte in 1852 (Proc. Phila. Acad. Nat. Sciences, 1852, p. 160).

n 1827 Lichtenstein described, under the name *Ascomys mexicanus*, ee specimens of pocket gophers collected by Deppe on the table-d of Mexico, but the exact locality whence they came is unknown ants Muizen, 1827, 27–31). The specimens differed greatly among mselves in color, as originally described by Lichtenstein, and their nial measurements, kindly furnished me by Dr. Matschie, show that y belong to at least two different genera. The case as it stands, refore, seems to be as follows: Lichtenstien's *mexicanus* is composite ‡

Following is a translation of the original description: "On the Tucan, or a ain kind of Indian mole. Chap. XXIV. [The Tucan] is apparently a species of e 9 inches in length, and equaling the humerus of man in size; it is fleshy, fat, furnished with such short legs that it almost touches the ground with its belly; , fulvous; tail, short; claws and nails, long; snout, murine; ears, small and nd; front [teeth], two above and same in number below, considerably exserted curved inward; [the other teeth], though much smaller, are very strong. When he flesh is edible, of pleasant taste, but causes stupor. * * *."—(Francisco nandez, Historiæ Animalium et Mineralium Novæ Hispaniæ, Liber 1, 1651, pp. 7–8.)

All the American moles were at that time placed with the shrews in the genus *r*, the genera *Scalops*, *Scapanus*, and *Condylura* not having been proposed until etime later.

From the cranial measurements kindly furnished me by Dr. Matschie, and now he first time published, it is evident that one of Lichtenstein's specimens was a *ygeomys* closely related to, if not identical with, the animal here described as *lanicep*s.

and is preoccupied by *mexicanus* of Kerr (1792). The latter is unide ifiable, the vague description applying equally well to several speci It being clearly impossible to use the name *mexicanus*, it should dropped from the group.

Cranial measurements of two of Lichtenstein's type specimens of Ascomys mexicanu

[Measured by Dr. Paul Matschie.]

	[illegible]	18[illegible]
Greatest basal length (condyle to front of premaxilla)	....	[illegible]
Basal length (basion to gnathion)	....	[illegible]
Basilar length of Hensel (basion to alveolus of incisor)	....	[illegible]
Greatest zygomatic breadth	....	[illegible]
Greatest breadth posteriorly across squamosals	....	[illegible]
Least breadth between postglenoid notches	....	[illegible]
Least interorbital breadth	....	[illegible]
Height of cranium above palate	....	[illegible]
Height of cranium above basion	....	[illegible]
Length of upper molar series on alveoli	14.5	[illegible]
Length of diastema	25.5	[illegible]
Length of single mandible without teeth	42.5	[illegible]
Breadth across angular processes	54	[illegible]
Distance from condyle to end of angular process	20	[illegible]
Breadth across muzzle just in front of zygoma	13	[illegible]

(B.) Tables of Average Measurements of the Variou Species.

Average measurements of the species of Geomys.

[All measurements are in millimeters and from fresh specimens.]

Name of species.	Locality.	Number of specimens.			Total length.		Tail vertebræ.		Hind fo[illegible]
		Total.	♂	♀	♂	♀	♂	♀	♂
G. bursarius	Southeastern North Dakota	16	6	10	296	265	90	78	37
	Elk River, Minnesota	40	20	20	284	243	......	......	......
	Hunter and Williamsville, Missouri	12	4	8	256	223	74	63	33
G. lutescens	Western Nebraska*	22	12	10	270	246	84	72	33.5
	Childress, Texas	10	4	6	257	228	81.5	68	30
G. breviceps	Mer Rouge, Louisiana*	38	15	23	231	213	70	61	28
	Benton, Arkansas	7	4	3	243	206	74	66.3	29
	Fort Gibson, Indian Territory	14	5	9	233	209	68.2	61.7	27.8
	Mineola, Texas	14	6	8	220.5	193.2	67.8	57.2	26.3
	Melano, Texas	11	5	6	216.2	206	63.8	60.3	26.4
G. sagittalis	Galveston Bay, Texas*	20	5	15	220	196	64	54	26
	Houston, Texas	9	5	4	226	208	64	57	25
G. attwateri	Rockport, Aransas County, Texas*	17	10	7	255	220	80	68	30
G. texensis	Mason, Texas*	28	......	......	(†)	......	......	......	......
G. arenarius	El Paso, Texas*	32	8	24	260	‡250	83	‡78	32
G. personatus	Padre Island, Texas*	13	4	9	315	293	111	100	40
G. fallax	South side Nueces Bay, Corpus Christi, Texas*	13	9	10	263	236	87	75	34
G. tuza	Augusta, Georgia*	19	10	9	269	249	89.5	82	34.4
	Butler, Georgia§	10	5	5	257	241	82	74	33.8
G. mobilensis	Mobile Bay, Alabama*	8	4	4	250	229	81	76	33.6
G. floridanus	San Mateo, Florida	6	3	3	288	235	94	77	35.5

* *Type locality.*

† Average of 28 specimens of both sexes: total length, 210; hind foot, 28.

‡ Some of the specimens of *arenarius* recorded as females are very large and were probably [illegible] hence the averages here given for females are probably too great.

§ The specimens from Butler, Ga., are clearly intermediate between *tuza* and *mobilensis*.

Average measurements of the species of Cratogeomys.

[All measurements are in millimeters and from fresh specimens.]

species.	Locality.	Number of specimens.			Total length.		Tail vertebræ.		Hind foot.	
		Total.	♂	♀	♂	♀	♂	♀	♂	♀
mi	Valley of Mexico, Mexico	18	11	7	380	344	113	105	50	46
	Atlixco, Mexico	7	4	3	328	289	94.5	85	47	43.5
	Irolo, Hidalgo, Mexico..........	3	....	3	......	324	......	91	......	42.6
sis	Cofre de Perote, Mexico	12	....	12	......	310	......	88	......	41.5
....	Las Vigas, Mexico.............	8	4	4	313	277	89	75	42	37
rs	Mount Popocatapetl, Mexico ..	1	....	1	......	318	......	92	......	43
inus	Mount Iztaccihuatl, Mexico...	1	....	1	......	304	......	87	......	42
ops	Las Animas, Colorado	4	1	3	295	256	95	77	37	33
	Albuquerque, New Mexico	3	....	3	......	259	......	77	......	34
	Eagle Pass, Texas.............	....	....	....	......	......	......	......	......	......
ops gold										
....	Cañitas, Zacatecas, Mexico....	3	....	3	......	257	......	82.7	......	34.3
ens.......	Chalchicomula, Puebla, Mexico.	9	3	6	327	302	105	97	43	39.6

measurements of the species of Platygeomys, Orthogeomys, Heterogeomys, Pappogeomys, and Zygogeomys.

[All measurements are in millimeters and from fresh specimens.]

of species.	Locality.	Number of specimens.			Total length.		Tail vertebræ.		Hind foot.	
		Total.	♂	♀	♂	♀	♂	♀	♂	♀
mys gymnu-	Zapotlan, Jalisco, Mexico ...	6	3		353	341	105	9:	53.5	49.5
	Sierra Nevada de Colima, Jalisco, Mexico.	2			......	322	......	85	......	49
inus	Tula, Hidalgo, Mexico	3	1	2	345	298	100	91.5	45	39.5
	Patzcuaro, Michoacan, Mexico.	5	3	2	348	331.5	101.5	91.5	49.5	45.5
eps	N. slope Volc. Toluca, Mexico, Mexico.	3	1	2	372	336.5	121	100	46	43
us	Colima City, Mexico	10	7	3	287.5	277	82	75	42	39.5
mys scalops..	Cerro San Felipe, Oaxaca, Mexico.	10	2	8	369	360	103.5	109	50	50
mys nelsoni..	Mount Zempoaltepec, Oaxaca, Mexico.	3	2	1	416	380	131	118	54	52
omys hispi-	Jico, Vera Cruz, Mexico.....	5	2	3	345	311	92	85	53	47
us	Motzorongo, Vera Cruz, Mexico.	14	4	10	348	317	96.5	81.5	49	45.5
	Chichicaxtle, Vera Cruz (type), Mexico.	1	....	1	......	323	......	88	......	52
omys bulleri .	Sierra Nevada de Colima, Jalisco, Mexico.	6	2	4	236	216	81	72	33	30
omys albi-	Guadalajara, Jalisco	1	....	1	......	226	......	68	......	31
mys trichopus	Nahuatzin, Michoacan......	10	3	7	343	323	111	106	46	43

(C.) Tables of Cranial Measurements.

Table A.—*Cranial measurements of Geomys bursarius, lutescens, breviceps, sagittalis, and attwateri.*

[All measurements are in millimeters. Museum numbers refer to U. S. National Museum unless contrary is stated.]

Museum number.	Sex and age.	Locality.	Greatest basal length (condyle to front of premaxilla).	Basal length (basion to gnathion).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals.	Breadth at postglenoid notch.	Interorbital breadth.	Height of cranium above palate.	Height of cranium above basion.	Upper molar series on alveoli.	Length of diastema.	Greatest length of single half of mandible without teeth.	Greatest breadth of mandible across angular processes.	Distance from condyle to angular process.	Breadth of muzzle at root of zygoma.	Ratios to basal length. Zygomatic breadth.	Ratios to basal length. Greatest squamosal breadth.	Ratios to basal length. Height of cranium above palate.
		Geomys bursarius.																Per ct.	Per ct.	Per ct.
49185	♂ ad	Portland, North Dakota	60	57	53.5	36	31.5	22	6.5	20	16	9.5	24.5	40	38	14	11	63.1	55.2	35
2766*	♂ old	Knoxville, Iowa	59.5	57	53	37.5	34	23.5	7	21	17.5	10	24	40	41.5	15	11	65.8	59.6	36.8
2625*	♂ ad	do	59	57	52.5	36	33	21	7	20	16	10	22.5	39.5	37	14	11	63.1	57.9	35
2772*	♂ ad	do	59	56.5	52	37.5	34.5	22	7	21	17	10	24	40	39.5	15	11	66.3	61	37.1
2624*	♂ ad	do	58	55.5	51	38	33.5	23.5	7.5	20.5	17	9.5	23	39.5	40	15	12	......	......	......
4119*	♂ ad	Ortonville, Minnesota	58	5[illegible]	51	36	32	22.5	7	20	16	10	23	39.5	37	14.5	10.5	......	......	......
2621*	♂ ad	Knoxville, Iowa	54.5	51.5	48	33.5	30.5	20.5	6.5	18	16	9.5	22	36	33.5	11.5	10.5	......	......	......
2925*	♂ ad	Elk River, Minnesota	53.5	51	47	32	28.5	19.5	6.5	19	15	9.5	21.5	36	34	12.5	10.5	......	......	......
2930*	♂ ad	do	53.5	51.5	47.5	32	29	19	6.5	18.5	15.5	9	21.5	36.5	32	11.5	10	......	......	......
2024*	♀ ad	Knoxville, Iowa	50	47	43	30	29	21	7	17.5	14.5	8.5	19	33.5	30	11	10	......	......	......
2623*	♀ ad	do	48	45.5	42.5	28	27	19	6	17.5	14	9	18.5	33	27.5	10	10	......	......	......
2768*	♀ ad	do	47	44.5	41	28.5	26	19	7	16.5	13.5	8.5	16.5	32	28	10.5	9	......	......	......
2771*	♀ ad	do	45	42.5	39.5	27.5	26	19	6.5	16.5	13.5	8	18	30	29	10	9	......	......	......
		Geomys lutescens.																		
25471	♂ ad	Cherry County, Nebraska	50	48.5	44	32.5	27.5	20.5	7	18	13.5	8.5	19.5	33.5	32	12	10.5	67	56.6	37.1
25634	♂ ad	Chadron, Nebraska	47	44.5	40.5	32	27	20.5	7	17.5	13	9	18	32	29.5	10.5	10.5	71.9	60.6	39.3
25472	♂ ad	Myrtle, Nebraska	49	47	42	33	27.5	20	6.5	18	15	8.5	18	32.5	31	11.5	10.5	70	58.5	38.3
[illegible]	[illegible]	[illegible]	48	46	42	31	28	20	6.5	18	13.5	9	17.5	33.5	29	10.5	11	67.9	60.8	39.1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31	10	10	......	......	......

46661	♂ ad.	.....do	43.5	41.5	37.5	27	23	19	7	15.5	12	8.5	15.5	29	28	10	9	......	......	......
46665	♂ ad.	.....do	42.5	40	36.5	27	23.5	18	7	15	12	8.5	15.5	28.5	27	9	8.5	......	......	......
46666	♂ ad.	.....do	42	40	36.5	26.5	24	18	6	15	12.	8.5	15	28	26	8.5	8.5	......	......	......
46663	♂ ad.	.....do	42	40	36.5	27	24	18.	7	15.5	12	8	15	28.5	27.5	9.5	9	......	......	......
46650	♀ ad.	.....do	40.5	38	35	26	23	18	6.5	14.5	12	8	14	27	23	8	8	......	......	......
46657	♀ ad?	.....do	39.5	37	34	24	22.5	17.5	6.5	14		8.5	13	26.5	24	8	8.5	......	......	......
46682	♂ old.	Fort Gibson, Indian Territory	44.5	42	38	28.5	24.5	18	6.5	16	12.5	8.5	16	30	28.5	10	9	......	......	......
		Geomys sagittalis.																		
44957	♂ ad.	Galveston Bay, Texas (*type*)	41	39	36	27.5	23.5	18.	6	16	12.5	8.5	15.5	28.5	27	8	9	70.5	60.2	41
		Geomys attwateri.																		
119†	♂ old.	Rockport, Texas	49.5	47	43.5	33.5	29	21		18.5	14.5	9	20	34.5	35.5	13.5	10	71.2	61.7	39.3
100†	♂ old.	.....do	49	47	43.5	31.5	27	21	6.5	18	13.5	8.5	19	34	33	12	10	67.8	57.5	38.3
44392	♂ ad.	Tallys Island, Texas	44	42	38.5	28.5	25	18.5	7	16.5	13	8.5	17	30	28	10	10	67.8	59.5	39.2
44321	♂ ad.	Rockport, Texas	44	......	......	[28]	25.5	18.5	6.5	16	13	9	16	30.5	27	10	9	......	......	......
51382	♂ ad.	Rockport, Texas (*type*)	42.5	40.5	38	27.5	24	18	7	16	12.5	8	16	30	27	10	9	67.8	59.2	39.5
44316	♀ ad.	Matagorda, Texas	40	38	35	25	22.5	18	6	14.5	12	8	14.5	28	......	8	8.5	65.7	59.2	38.1
51497	♀ ad.	Rockport, Texas	38	36	33.5	24.5	21.5	18	7	14.5	11.5	8	13	......	......	......	9	68.0	59.8	40.2
44222	♀ ad.	Matagorda, Texas	40	38	35	26.5	23.5	18.5	6.5	15	12	8	14.5	25.5	......	9	8.5	......	......	......
44317	♀ ad.	.....do	39.5	38	35	25	22.5	18	6	15	11.5	8	15	27.5	25	9	9	......	......	......

* Merriam collection. † Collection of H. P. Attwater.

TABLE B.—*Cranial measurements of Geomys personatus, fallax, texensis, and arenarius.*

[All measurements are in millimeters. Museum numbers refer to U. S National Museum unless contrary is stated.]

Museum No.	Sex and age.	Locality.	Greatest basal length (condyle to front of premaxilla).	Basal length (basion to front of premaxilla).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals (over mastoids).	Breadth at postglenoid notch.	Interorbital breadth.	Greatest height of cranium above palate.	Greatest height of cranium above inferior lip of foramen magnum.	Length of upper molar series on alveoli.	Length of diastema.	Greatest length of single half of mandible.	Greatest breadth of mandible across angular processes.	Distance from condyle to angular process.	Breadth of muzzle at root of zygoma.	Ratios to basal length: Zygomatic breadth.	Ratios to basal length: Greatest squamosal breadth.	Ratios to basal length: Height of cranium above palate.
		Geomys personatus.																*Perct.*	*Perct.*	*Perct.*
43294	♂ ad	Padre Island, Texas	56	53.5	49.5	36	33	24.5	7	20	16	11.5	21	38.5	36	14	12	67.2	61.6	37.3
43432	♂ ad	do	56	53.5	49	35.5	33	24	6.5	19.5	15	10	21	38.5	34	13	10.5	66.3	61.6	36.4
43434	♂ ad	do	54	51.5	47	34.5	32.5	23	6	18.5	15.5	11.5	19	37	34.5	13.5	11	66.9	63.1	35.9
43430	♂ yg. ad	do	53.5	51	47	33	30.5	23	6.5	18.5	15	10.5	18.5	37	33	12.5	11	64.7	59.8	36.2
43436	♀ ad	do	53	50	46	31.5	29	21	7	18.5	14.5	10	19	35.5	30.5	12	10.5	......	......	......
43429	♀ ad	do	51	48.5	45	31.5	28	22	7.5	18.5	15	10.5	18	35	31.5	12	11	......	......	......
43438	♀ ad	do	51.5	49	45.5	31.5	28.5	21.5	7.5	18.5	15	10	18.5	35	32	12.5	10.5	......	......	......
43433	♀ ad	do	51	48.5	44.5	31	29	22.5	7.5	18	14	10	18	34	31	11.5	11.5	......	......	......
43435	♀ ad	do	49	46.5	42	31.5	30	22	6.5	17.5	14.5	11	16.5	34.5	......	12	10.5	......	......	......
		Geomys fallax.																		
43840	♂ ad	South side Nueces Bay, Texas	46	43.5	40	28	27	20	6	17	13.5	9	16	32	30	10.5	9	64.3	62	39
43845	♂ ad	do (type)	45.5	43.5	39.5	30	27.5	20	6.5	16.5	14	8.5	17	31	31.5	11.5	8.5	68.9	63.3	37.9
43259	♂ ad	do	45	42	39	27.5	25.5	19.5	6.5	16.5	13.5	9	16	30	28	10	9	65.4	60.7	39.2
43843	♂ ad	do	45	42	39	27.5	27	20.5	6	16	13	9	15.5	31	30	11	8.5	65.4	64.2	38
43262	♂ yg. ad	do	45	42.5	39	27.5	26	20.5	6.5	17	13	9	15.5	30	28	10.5	9	......	......	......
43842	♀ ad	do	42	39.5	36	26	24	19.5	7	16	13.5	8.5	15	29	26	9	8.5	......	......	......
43841	♀ ad	do	42	39.5	36	25	24.5	19.5	6.5	16	13	8.5	14.5	28.5	25.5	9.5	8.5	......	......	......
43292	♀ ad	do	41.5	39.5	36	26.5	24.5	20	6.5	16	13	8.5	14.5	28.5	28	10	9	......	......	......
43844	♀ ad	do	40.5	38.5	35	25	23.5	18	6.5	15.5	12.5	8	14	28	26	9.5	8.5	......	......	......
43293	♀ ad	do	40.5	38	35	25	23	18.5	6	15.5	12.5	8.5	13.5	27	25.5	9.5	8.5	......	......	......
		Geomys texensis.																		

[illegible]*	♀ ad	do	38	35.5	32	23.5	22	17.5	7	14.5	11.5	7.5	12.5	25.5	24	8	8	......	......	......
4172*	♂ ad	do	39	37	33	25	22	17.5	6.5	15	11	8.5	12.5	26	26	8.5	9	......	......	......
[illegible]*	♀ ad	do (type)	37.5	35	32	23	20.5	17	6	14	11.5	7.5	12.5	25	24	7.5	8	......	......	......
		Geomys arenarius.																		
35015	♂ ad	El Paso, Texas (type)	43	40.5	37	27	23.5	18.5	7	16	12	8	15	28.5	26.5	9	9	66.6	58	39.5
55340	♂ old	do	42.5	40.5	37	28	24.5	18.5	6.5	15.5	12	8	15	28	28	9.	9.5	69.1	60.4	35.8
55334	♂ yg. ad	do	43	40	36.5	25.5	23.5	19	7	15.5	12	8	14.5	28	24.5	9	9	63.7	58.7	38.7
33787	♂ ad	do	42	39.5	36	25.5	23.5	18	6	15.5	11.5	7.5	14.5	28.5	27	9	8.5	64.5	59.4	39.2
55339	♂ ad	do	41.5	39	35.	25	24.5	19	6.5	15	12	8.5	13.5	28	27	9	9	......	......	......
34973	♀ old	do	41	38.5	35	26	23	17.5	6.5	15.5	10.5	7.5	14.5	27	26.5	9	9	......	......	......
55337	♀ ad	do	41	39	35	25.5	24	18	6	15.5	11.5	8	14	27	26	9	9	......	......	......
55013	♀ ad	do	40.5	38	35	25.5	23	18	6	15	11.5	8	13	27	25	9	9	......	......	......
35016	♀ ad	do	40	37.5	34	24	23	18	6.5	15	11	8	13	27	26	9	8.5	......	......	......

* Merriam collection.

		Zygogeomys trichopus.																		
50104[1]	♂ ad	Nahuatzin, Michoacan, Mexico	61	58.5	54	39	35.5	25	9.5	20	17.5	11.5	24.5	42	40	15.5	11.5	66.6	62	34.1
50100	♂ ad	do	61	58	53.5	38.5	35	25	8.5	21	18	12	23	40	42.5	15	11.5	66.3	60.3	36.2
50107	♂ ad	do (*type*)	60	56.5	53	37	33.5	25	8	21	18	11	24	40	40	14.5	11.5	65.4	59.2	37.1
50099	♂ ad	do	59.5	56	52	38.5	33.5	25	8	21	18	12	23	39	40	15	11.5	68.7	59.8	37.5
50105	♀ ad	do	57	53.5	49.5	35.5	33.5	25	8.5	20.5	16.	1.5	22	37.5	35	14	11.5	66.3	62.6	38.3
50108	♀ ad	do	56.5	53.5	49	36	33	25	8	20	17.5	11	21	37.5	37	13.5	10.5	......	......	......
50103	♀ ad	do	56	53.5	49.5	35.5	34	25.5	8	20	17	11.5	22	37	38	14	10.5	......	......	......
50101	♀ ad	do	55	52	48	37	32.5	24.5	8	20	16	10.5	21.5	37	36.5	13	11	......	......	......
50102	♀ ad	do	52.5	49.5	46	34.5	30	23	8	20	15.	11.5	18.5	35	34	12	10.5	......	......	......
47187	♀ ad	Patzcuaro, Michoacan, Mexico	50	46.5	43	30.5	29	21	8	18.5	15	11.5	18	33	32	11.5	10	......	......	......

[1] Merriam collection.

TABLE D.—*Cranial measurements of the species of Cratogeomys.*

[All measurements are in millimeters. Museum numbers refer to U. S. National Museum unless contrary is stated.]

Museum number	Sex and age.	Locality.	Greatest basal length (condyle to front of premaxilla).	Basal length (basion to front of premaxilla).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals (over mastoids).	Breadth at postglenoid notch.	Interorbital breadth.	Greatest height of cranium above palate.	Greatest height of cranium above inferior lip of foramen magnum.	Length of upper molar series on alveoli.	Length of diastema.	Greatest length of single half of mandible.	Greatest breadth of mandible across angular processes.	Distance from condyle to angular process.	Breadth of muzzle at root of zygoma.	Ratios to basal length. Zygomatic breadth.	Greatest squamosal breadth.	Height of cranium above palate.
		C. merriami.																Per ct.	Per ct.	Per ct.
57970	♂ old	Amecameca, Mexico (giant)	74.5	70.5	64	49	48.5	33.5	9.5	28.5	21	15.5	28.5	52	53	21	17	69.5	68.7	40.4
50110	♂ ad.	Lerma, Mexico	70	66.5	61	47	42	31	9	25	18.5	13	29	47	48.5	17.5	15.5	70.6	63.4	37.5
50112	♂ ad.	Tlalpam, Mexico	68	64.5	58.5	42.5	39	29	8	25.5	19.5	13.5	26.5	45	46.5	17	15.5	65.8	60.4	39.5
51447	♂ ad.	Amecameca, Mexico	67.5	64.5	58.5	45	41.5	30	6.5	27	19.5	13.5	26	46	47	17.5	14.5	69.7	64.3	41.8
51446	♂ ad.	do.	67	63	57	45.5	41	31	8.5	26.5	19.5	14	26	45	51	18.5	15	72.1	65	42
51158	♂ ad.	Huitzilac, Mexico	67	64	58.5	44.5	43.5	31.5	9	24.5	19	13.5	25.5	44	50	18.5	14.5	......	......	......
50113	♂ ad.	Tlalpam, Mexico	65.5	62	57	44.5	39.5	31	8.5	24.5	18.5	12.5	26	46	48	17	14.5	......	......	......
55347	♂ ad.	Atlixco, Mexico	64	60	54.5	45	43.5	31	9	25	18	12	25.5	45	51	19.5	15	......	......	......
55346	♂ ad.	do.	63	60	54.5	42.5	42	29	9	24	18	12.5	24.5	44	47	17	14	......	......	......
50109	♂ yg. ad.	Salazar, Mexico	61.5	58	53.5	40	39	29	8	23	17	12.5	24	41	43	15.5	14	......	......	......
50114	♀ ad.	Tlalpam, Mexico	60.5	57.5	52.5	41	37	26	7.5	23.5	18	12.5	23	41	43.5	16	13.5	71.8	64.3	40.8
53494	♀ ad.	Irolo, Mexico	60	56.5	51	40.5	38	31	8	23	17	12	22	40	42	15	14.5	......	......	......
53496	♀ ad.	do.	59.5	56.5	51	40.5	37.5	30.5	9	23.5	17.5	12	22	40	42	14.5	13.5	......	......	......
53495	♀ ad.	do.	59.5	......	......	39.5	38	29.5	7.5	23	17	12	22.5	39.5	41	15	13	......	......	......
55351	♀ ad.	Atlixco, Mexico	57.5	54	49	38	35	26	9	22.5	16.5	11.5	21.5	39	42	15	13	......	......	......
55350	♀ ad.	do.	54	51	46.5	35	33	24	8.5	21	15	11.5	19.5	36.5	40	15	12.5	......	......	......
		C. perotensis.																		
54295	♀ ad.	Cofre de Perote, Mexico	58.5	55	50.5	39.5	36	27	7.5	22.5	16.5	12	21	40.5	40.5	15.5	12	71.7	65.3	40.9
54296	♀ ad.	do.	58.5	55	51	[illegible]	[illegible]	[illegible]	7.5	[illegible]	17	[illegible]	[illegible]	40	41	15	11.5	70.9	63.6	40.9
																		70.3	63.8	41.8

		C. peregrinus (type).																		
57964	♀ old	Mount Ixtaccihuatl, Mexico	55.5	52	47.5	35	34.5	27.5	7.5	21.5	15	11.5	20	37	35	13	12	65.3	66.3	41.3
		C. castanops.																		
47368	♂ ad	Las Animas, Colorado	54	51	46.5	38	30.5	23	7	20.5	15.5	10.5	21	36.5	38	14	11	74.5	59.8	40.1
47364	♀ ad	do	50	47	43	32.5	28	22	7	19.5	14.5	9.5	19.5	33.5	32.5	12.5	10	69.1	59.5	41.5
47363	♀ ad	do	47.5	44	41	31	27	21.5	7.5	18.5	14	10	18	32	31	11.5	10	70.4	61.3	42
47365	♀ ad	do	47.5	44.5	40.5	30	26.5	21	6.5	18	13.5	10	18	31.5	31	11	10	......	......	......
25108	♂ ad	Marfa, Texas	56	53	49	37.5	33.5	22	7	21.5	15.5	9.5	22	38	38	14.5	10.5	......	......	......
51048	♂ ad	Jaral, Mexico	56.5	53.5	49	......	32.5	24	7.5	20.5	15.5	10.5	22.5	38	......	14	12	......	......	......
51049	♂ yg.ad	do	53.5	50.5	47	34	30	22.5	7	20	15	10	21.5	36	36	12.5	11.5	......	......	......
		C. castanops goldmani.																		
57968	♀	Cañitas, Zacatecas, Mexico	49	46	42.5	32	27.5	21.5	7.5	18.5	13.5	9	18.5	32.5	33	11.5	10.5	69.5	59.7	40.2
57965	♀	Cañitas, Zacatecas, Mexico (*type*)	47.5	44.5	41	32.5	29	21	7.5	18	13	9.5	18.5	31	33	12	10.5	73	65.1	40.4
		C. fulvescens.																		
58168	♂ ad	Chalchicomula, Puebla, Mexico (*type*)	58	55	50.5	40	34	26	7.5	22.5	17	12	22	38	40	14	12.5	72.7	61.8	40.9
58166	♂ yg.ad	Chalchicomula, Puebla	56	52	48	38.5	33.5	25	8	22	17	12	21	38.5	41	14.5	13	74	64.4	42.3
53497	♀ ad	do	54.5	51	47	35.5	30	22.5	7.5	22	16.5	11	20	36.5	36	13	12	69.6	58.8	40.1
53496	♀ ad	do	54	51	47	35.5	30.5	24	6.5	20.5	15.5	10.5	20	36.5	36.5	12	11.5	......	......	......
58169	♀ ad	do	52	49	45	34	29.5	23	7	21	16	10	19	35	33	12.5	11	......	......	......

TABLE E.—*Cranial measurements of the species of Platygeomys.*

[All measurements are in millimeters. Museum numbers refer to U. S. National Museum unless contrary is stated.]

Museum number.	Sex and age.	Locality.	Greatest basal length (condyle to front of premaxilla).	Basal length (basion to front of premaxilla).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals (over mastoids).	Breadth at postglenoid notch.	Breadth across postorbital processes.	Interorbital breadth.	Greatest height of cranium above palate.	Greatest height of cranium above inferior lip of foramen magnum.	Length of upper molar series on alveoli.	Length of diastema.	Greatest length of single half of mandible.	Greatest breadth of mandible across angular processes.	Distance from condyle to angular process.	Breadth of muzzle at root of zygoma.	Ratio to basal length.		
																			Zygomatic breadth.	Greatest squamosal breadth.	Greatest height of cranium above palate.
		P. gymnurus.																	*Per ct*	*Per ct*	*Per ct*
45614	♂ ad	Zapotlan, Jalisco, Mexico (*type*)	66	62.5	57.5	45	48	34	......	10	24	20	14	26	43	57.5	21	15	72	76.8	38.4
45611	♂ ad	Zapotlan, Mexico	66	62	57	47	49.5	35.5	......	9.5	23	19	14.5	25	45	63	23.5	15	75.8	79.8	37
45610	♂ ad	do	65.5	62	57.5	46.5	47	33	......	10	24	19	14	25.5	42	56	20	15	75	75.8	38.7
46214	♂ ad	do	65	61	56	44.5	47	34	......	10	23	18	14.5	24	41.5	57	20.5	15.5	72.9	77	37.7
45609	♂ ad	do	64	60	56	46	46.5	33	......	10	23.5	18.5	14	23.	42	57	20	15	......	......	......
45613	♂ yg. ad	do	62.5	59	54.5	44	44.5	30.5	......	9	23	17.5	14	23	41	56	19.5	15	......	......	......
45615	♀ ad	Sierra Nevada de Colima, Jalisco	62.5	58.5	53.5	43.5	44.5	32	......	9.5	23	18.5	14.5	22	41.5	49	19	14.5	69.6	74.3	39.3
45616	♀ ad	do	60	57	53	42	42.5	31	......	9.5	22	18	13	22.5	42	52	20	14	......	......	......
		P. tylorhinus.																			
51883	♂ ad	Tula, Hidalgo, Mexico (*type*)	61.5	58	54.5	43	44	31	......	8	23.5	18.5	12	24.5	42	52	18.5	12.5	88.6	69.9	38.2
51881	♀ ad	Tula Hidalgo	53	50	47	36	36.5	27	......	7.5	21	15.5	12.5	19	35	42	15	11	88.6	67.9	39.0
51884	♀ im	do	51	48	45	33.5	36	26	......	7.5	20	14.5	10.5	20	34	40.5	13.5	10.5	88.2	65.6	39.2
47183	♂ ad	Patzcuaro, Michoacan, Mexico	66	62	57	46	46	32.5	......	9	24.5	19.5	13	25	44	56	19	16	74.2	74.2	39.5
47182	♂ ad	do	64.5	60	56	42	44	31	......	9	23.5	17	13	24	43	48	18.5	14	70	73.3	39.1
47181	♀ ad	do	61	56.5	52.5	42	44	32	......	8	23	18.5	12	23	40	51	17.5	12.5	74.3	77.8	40.7
47185	♀ ad	do	60.5	56.5	53	41.5	44	32	......	7.5	22.5	18	12.5	23	40	50	17	13	......	......	......
47184	♂ yg. ad	do	59	55	52	40	40.5	28.5	......	7.5	23	16.5	12	23	40	46	17	12	72.7	73.6	41.8
		P. planiceps.																			
55906	♂ ad	Volcan Toluca, Mexico (*type*)	63	59	55	42.5	43.5	30	......	8	22.5	17.5	18	24	41	51	18	13	72	72.7	38.1

[illegible]	[illegible]	[illegible]																				
45208	♂ ad	....do	53.5	50	46.5	37	36	28.5	......	8.5	19	15.5	12	19.5	35.5	44	14.5	12.5	74	72	38
45212	♀ ad	....do	52	49.5	45.5	36	36	29	......	8.5	20	15	12	19	35.5	43	14	12.5	72.7	72.7	40.4
45214	♀ ad	....do	52	49	45	35.5	34.5	27.5	......	8	19.5	14.5	11.5	19	35.5	40.5	14	11.5	72.4	70.4	39.8
45205	♀ yg. ad	....do	51.5	49	44.5	35.5	33.5	28	......	8	19	13.5	11.5	18.5	34.5	41.5	14	12.5	72.4	68.3	38.8

TABLE F.—*Cranial measurements of the species of Pappogeomys, Orthogeomys, Macrogeomys, and Heterogeomys.*

[All measurements are in millimeters. Museum numbers refer to U. S. National Museum unless contrary is stated.]

Museum number.	Sex and age.	Locality.	Greatest basal length (condyle to gnathion).	Basal length (basion to gnathion).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals.	Breadth at postglenoid notch.	Breadth between postorbital processes.	Interorbital breadth.	Height of cranium above palate.	Height of cranium above basion.	Upper molar series on alveoli.	Length of diastema.	Greatest length of single half of mandible without incisor.	Greatest breath of mandible between angular processes.	Distance from condyle to angular process.	Breadth of muzzle at root of zygoma.	Ratios to basal length. Zygomatic breadth.	Ratios to basal length. Greatest squamosal breadth.	Ratios to basal length. Height of cranium above palate.
		Pappogeomys bulleri.																			
																			Per ct	*Per ct*	*Per ct*
45622	♂ ad ...	Sierra Nevada de Colima, Jalisco, Mexico.*	40	38	35	25.5	24	19.5	......	7	16	12.5	9	14	28	26.5	9	8.5	67.1	63.1	42.1
45619	♀ ad....	.....do....................	39	36.5	33.5	25	23	19	......	8	15.5	12	9	13.5	27	26	9	8	65.7	60	44.8
45623	♀	.....do....................	37.5	35	32	23	21	18.5	......	7	15.5	12	8.5	13.5	25	24	8	8	65.7	60	44.8
		Pappogeomys albinasus.																			
46215	♀ ad....	Guadalajara, Jalisco (*type*)..	39.5	36.5	33	25.5	23.5	20.5	......	7.5	15	12	9.5	12.5	25	26.5	9	9	69.8	64.3	41
		Orthogeomys scalops.																			
67029	♂	Cerro San Felipe, Oaxaca...	67.5	64	59.5	42	40	27	16.5	14	25.5	19.5	14	25	45	43.5	16	14	65.6	62.5	39.8
67030	♂	.....do....................	67	63	57.5	41.5	42	28.5	18.5	15	26.5	20.5	13	26	46.5	42.5	16	14	65.8	66.6	42
65973	♀	.....do....................	67	63.5	58	37	40	27.5	17	15	25.5	19.5	14.5	25	45.5	43.5	16	13	58.2	62.9	40.1
67033	♀	.....do....................	66	62	57	38	41	28	18	15	26	20	14	24.5	44.5	40.5	15.5	14.5	......	......	......
67026	♀	.....do....................	64.5	60.5	55.5	37.5	40	29	18.5	16	25	19	14	23	43.5	38	14.5	14.5	......	......	......
79.1.6.2.1	....	Tehuantepec (*type*)‡	......	63	56.7	40.8	39	26.7	16.2	14.2	......	18.4	......	24.5	......	......	......	15	......	......	......
		Orthogeomys grandis.																			
65.5.18.65.1	ad	Dueñas, Guatemala (type)!	[illegible]	[illegible]	[illegible]													[illegible]	64.4	65	42.6

		Macrogeomys costaricensis																			
22551	im	Pacuare, Costa Rica (*type*)	52	48.5	44.5	33	29.5	23	15.5	9	21.5	16	13	20	37	35	12.5	14	68	60.8	44.3
		M. cherriei																			
C. R. N. M. 664	im	Santa Clara, Costa Rica (*type*)	51	47.5	44	34	30	23.5	15	9.5	21.5	16	12	20	37	(?34)	12.5	13	71.5	63.1	45.2
		Heterogeomys hispidus																			
55016	♂	Jico, Vera Cruz, Mexico	......	......	......	45	42.5	30.5	14.5	11	25.5	19.5	14	......	42	48.5	18	......	......	......	......
55343	♂	do	61	57.5	53	38	39.5	28.5	15	11.5	24.5	17	13.5	22	40	43.5	16	14	66	69.6	42.6
55060		do	......	......	......	37.5	......	29.5	14.5	11.5	24.5	......	13.5	22	39.5	......	......	13	......	......	......
55017	♀	do	58	55	51	37	37.5	28	15	10	23.5	17.5	14	20.5	38.5	40	15	12.5	67.2	68.1	42.7
55018	♀	do	......	......	......	36	37	28	15	11.5	23.5	17	13.5	......	38	41	15.5	......	......	......	......
		Heterogeomys torridus																			
63629	♀ ad	Chichicaxtle, Vera Cruz, Mexico (*type*)	60.5	57	52.5	41	39	28	15.5	11	23	18	13.5	21	41	46.5	17.5	15	71.9	68.4	40
63645	♂ ad	Motzorongo, Vera Cruz	60.5	57	52	41.5	40.5	30	14	11	23.5	18	13.5	21.5	40	45	16.5	15	72.8	71	41
63632	♂ ad	do	63.5	60	55.5	43.5	41	30	15.5	10.5	25	19.5	14.5	23	42	46	18	15	72.5	68.3	40.1
63635	♀	do	57	54	50	38.5	38	29	13.5	11	23.5	18	13	21	38	42	16	12.5	71.2	70.3	33.3
63651	♀	do	57	54	50	37	36	28	13.5	10.5	23	18	13	20.5	38.5	42	15.5	13.5	68.5	66.6	33.3

* Type of *Geomys nelsoni* Merriam. † British Museum. ‡ Measured by Oldfield Thomas. ¶ Berlin Museum. § Measured by Dr. Paul Matschie.

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[Names of genera and species are in heavy type.]

		C. oreocetes (type).																		
57963	♀ yg.ad	Mount Popocatapetl, Mexico	54.5	51	47	32.5	32	24	8	20	15	10.5	20	36	34	13	12.5	63.7	62.7	39.3
		C. peregrinus (type).																		
57964	♀ old	Mount Ixtaccihuatl, Mexico	55.5	52	47.5	35	34.5	27.5	7.5	21.5	15	11.5	20	37	35	13	12	65.3	66.3	41.3
		C. castanops.																		
47368	♂ ad	Las Animas, Colorado	54	51	46.5	38	30.5	23	7	20.5	15.5	10.5	21	36.5	38	14	11	74.5	59.8	40.1
47364	♀ ad	do	50	47	43	32.5	28	22	7	19.5	14.5	9.5	19.5	33.5	32.5	12.5	10	69.1	59.5	41.5
47363	♀ ad	do	47.5	44	41	31	27	21.5	7.5	18.5	14	10	18	32	31	11.5	10	70.4	61.3	42
47365	♀ ad	do	47.5	44.5	40.5	30	26.5	21	6.5	18	13.5	10	18	31.5	31	11	10	......	......	......
25108	♂ ad	Marfa, Texas	56	53	49	37.5	33.5	22	7	21.5	15.5	9.5	22	38	38	14.5	10.5	......	......	......
51048	♂ ad	Jaral, Mexico	56.5	53.5	49	......	32.5	24	7.5	20.5	15.5	10.5	22.5	38	......	14	12	......	......	......
51049	♂ yg.ad	do	53.5	50.5	47	34	30	22.5	7	20	15	10	21.5	36	36	12.5	11.5	......	......	......
		C. castanops goldmani.																		
57968	♀	Cañitas, Zacatecas, Mexico	49	46	42.5	32	27.5	21.5	7.5	18.5	13.5	9	18.5	32.5	33	11.5	10.5	69.5	59.7	40.2
57965	♀	Cañitas, Zacatecas, Mexico (*type*)	47.5	44.5	41	32.5	29	21	7.5	18	13	9.5	18.5	31	33	12	10.5	73	65.1	40.4
		C. fulvescens.																		
58168	♂ ad	Chalchicomula, Puebla, Mexico (*type*)	58	55	50.5	40	34	26	7.5	22.5	17	12	22	38	40	14	12.5	72.7	61.8	40.9
58166	♂ yg.ad	Chalchicomula, Puebla	56	52	48	38.5	33.5	25	8	22	17	12	21	38.5	41	14.5	13	74	64.4	42.3
53497	♀ ad	do	54.5	51	47	35.5	30	22.5	7.5	22	16.5	11	20	36.5	36	13	12	69.6	58.8	40.1
53498	♀ ad	do	54	51	47	35.5	30.5	24	6.5	20.5	15.5	10.5	20	36.5	36.5	12	11.5	......	......	......
58169	♀ ad	do	52	49	45	34	29.5	23	7	21	16	10	19	35	33	12.5	11	......	......	......

TABLE E.—*Cranial measurements of the species of Platygeomys.*

asurements are in millimeters. Museum numbers refer to U. S. National Museum unless cont

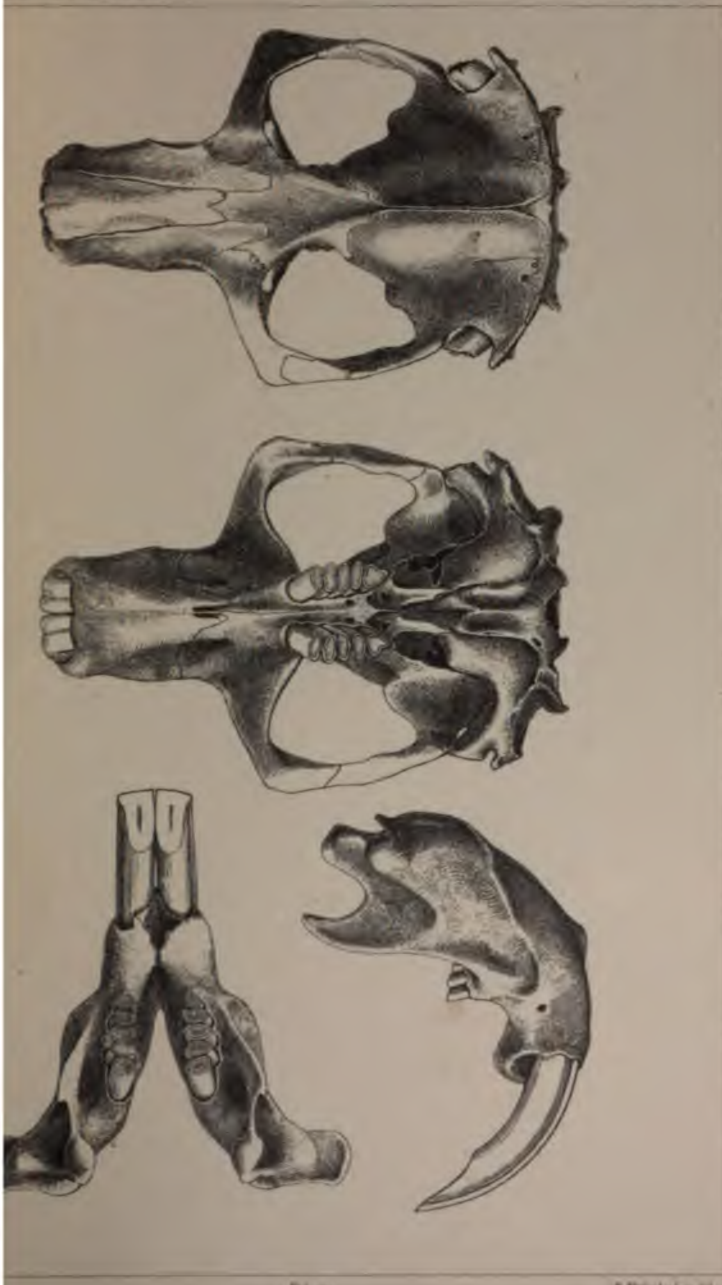
ty.	Greatest basal length (condyle to front of premaxilla).	Basal length (basion to front of premaxilla).	Basilar length of Hensel.	Zygomatic breadth.	Greatest breadth across squamosals (over mastoids).	Breadth at postglenoid notch.	Breadth across postorbital processes.	Interorbital breadth.	Greatest height of cranium above palate.	Greatest height of cranium above inferior lip of foramen magnum.	Length of upper molar series on alveoli.	Length of diastema.	Greatest length of single half

GEOMYS BURSARIUS (Shaw)

Knoxville, Iowa.

No. 2772. ♂ ad.

INDEX.



GEOMYS MERRIAMI Thomas

Lerma, Mexico.

No. 50110. ♂ ad.

PLATE 1.

(All natural size.)

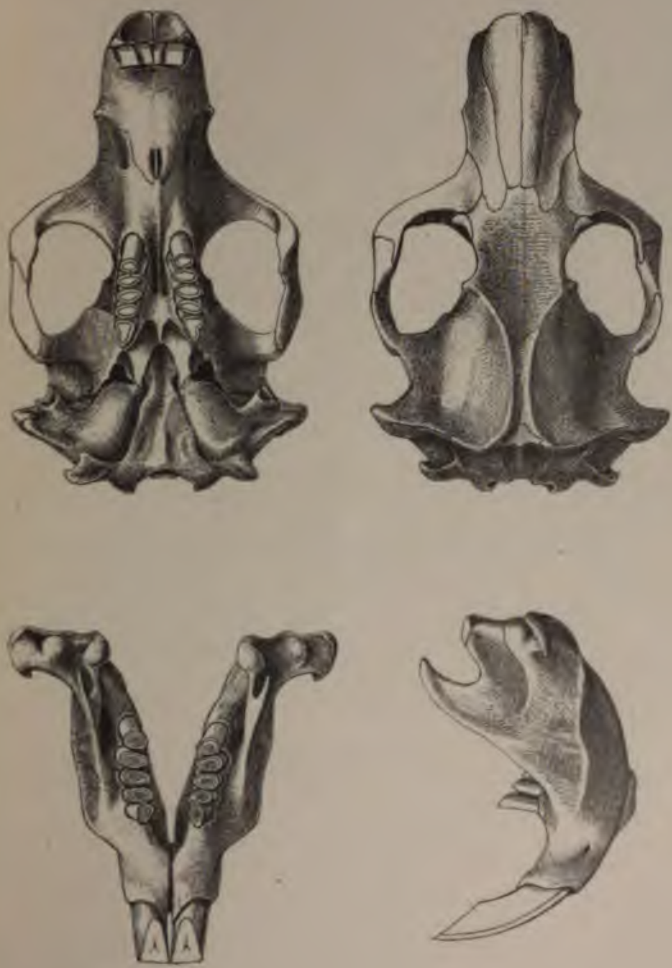
[illegible] Iowa.

[illegible]

PLATE 4.

(All natural size.)

Heterogeomys hispidus (LeConte). Jico, Vera Cruz, Mexico. (No. 55343 U. S. Nat. Mus.)



GEOMYS HISPIDUS. Le Conte

Jico, Vera Cruz, Mexico.

No. 55343 ♂ ad.

PLATE 5.

(All natural size.)

Macrogeomys dolichocephalus sp. nov. San Jose, Costa Rica.
(No. 36295 ♂ ad., U. S. Nat. Mus.)

GEOMYS DOLICHOCEPHALUS sp. nov.

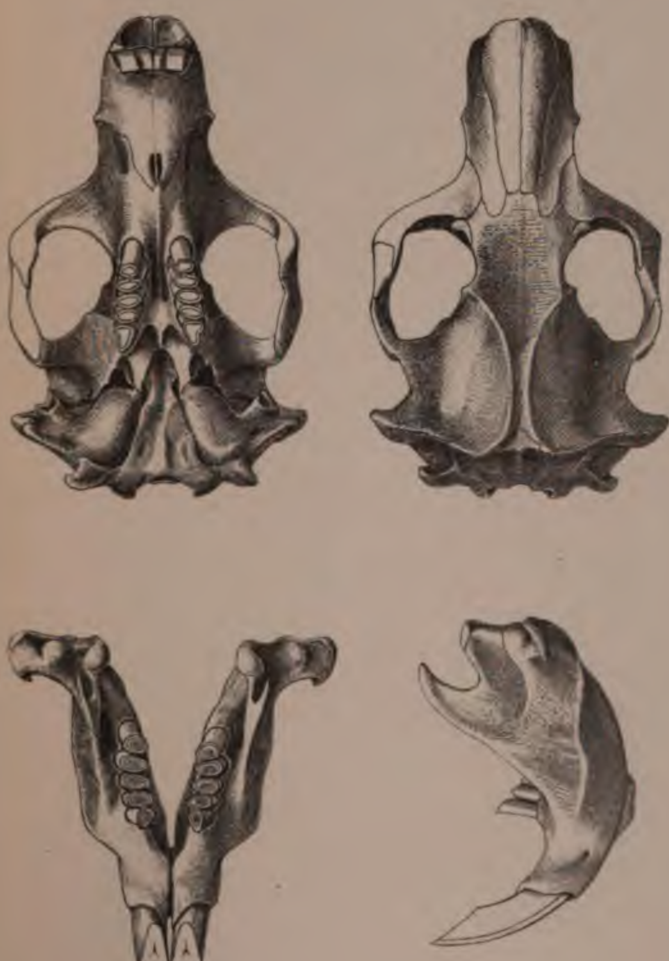
San José, Costa Rica.

No. 36295.

PLATE 6.

(All natural size.)

Zygogeomys trichopus sp. nov. Nahuatzin, Michoacan, Mexico. (No. 50107 ♂ ad., U. S. Nat. Mus.)



GEOMYS HISPIDUS. Le Conte

Jico, Vera Cruz, Mexico.

No. 55343 ♂ ad.

PLATE 5.

(All natural size.)

Macrogeomys dolichocephalus sp. nov. San Jose, Costa Rica. (No. 36295 ♂ ad., U. S. Nat. Mus.)

GEOMYS DOLICHOCEPHALUS sp. nov.

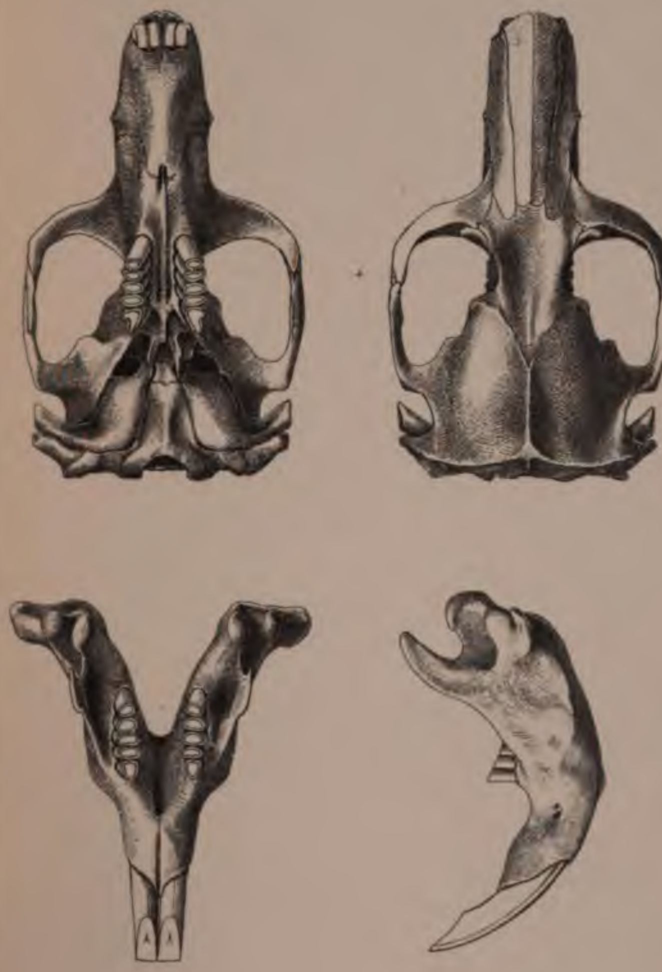
San José, Costa Rica.

No. 35295.

PLATE 6.

(All natural size.)

Zygogeomys trichopus sp. nov. Nahuatzin, Michoacan, Mexico. (No. 50107 ♂ ad., U. S. Nat. Mus.)



GEOMYS TRICHOPUS Merriam

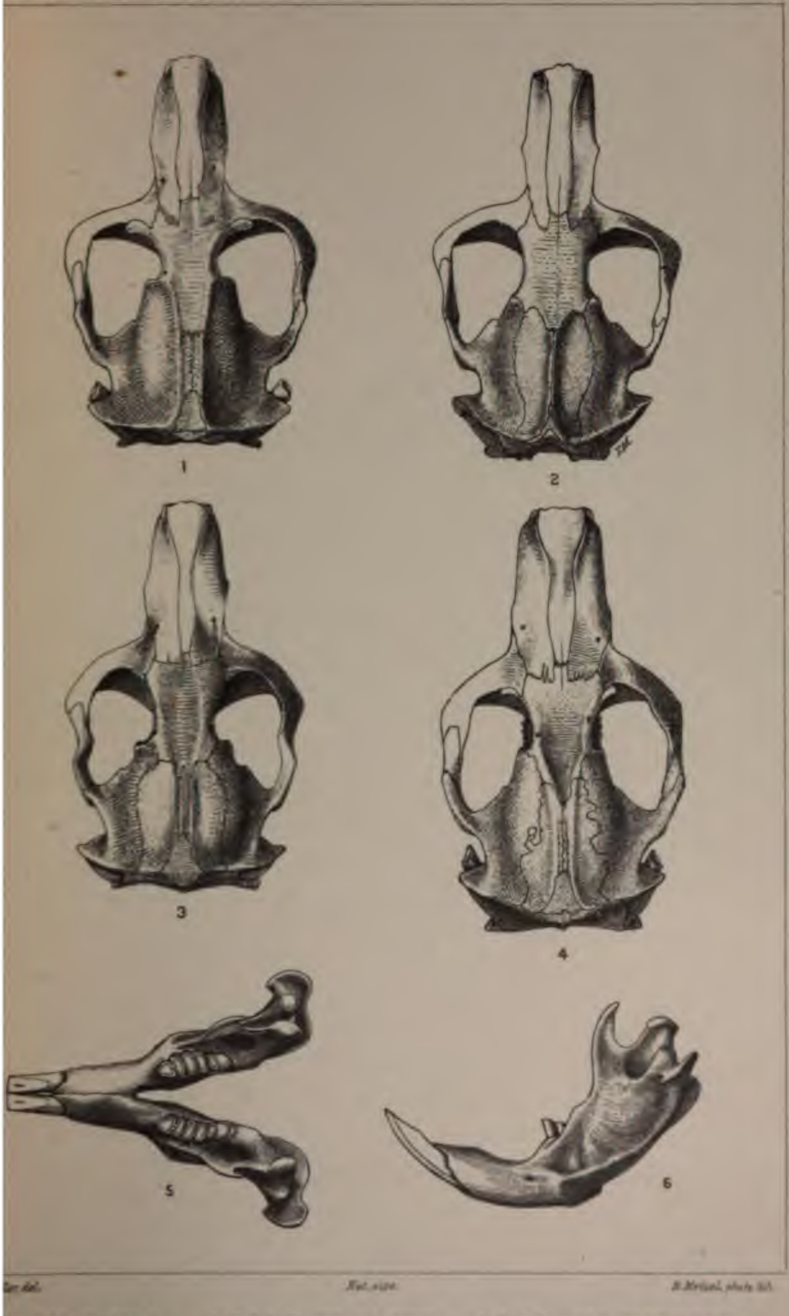
Nahuazin, Michoacan, Mexico.

No. 50107. ♂ ad.

PLATE 7.

(All natural size.)

1. *Geomys tuza* (Ord) ♂ ad. Augusta, Ga. (Type locality).
   (No. 58639 U. S. Nat. Mus.)
2, 5, 6. *G. tuza mobilensis* ♂ ad. Mobile Bay, Alabama. (Type locality).
   (No. 46024 U. S. Nat. Mus.)
3 and 4. *G. tuza floridanus* ♂ ad. San Mateo, Fla.
   (No. 6512 ♂ ad. and 6514 ♂ old, Merriam collection.)



...er del. Nat. size. B. Meisel, photo lith.

GEOMYS TUZA ♂ 2, 5 & 6. G. MOBILENSIS ♂ 3 & 4. G. TUZA FLORIDANUS ♂

PLATE 8.

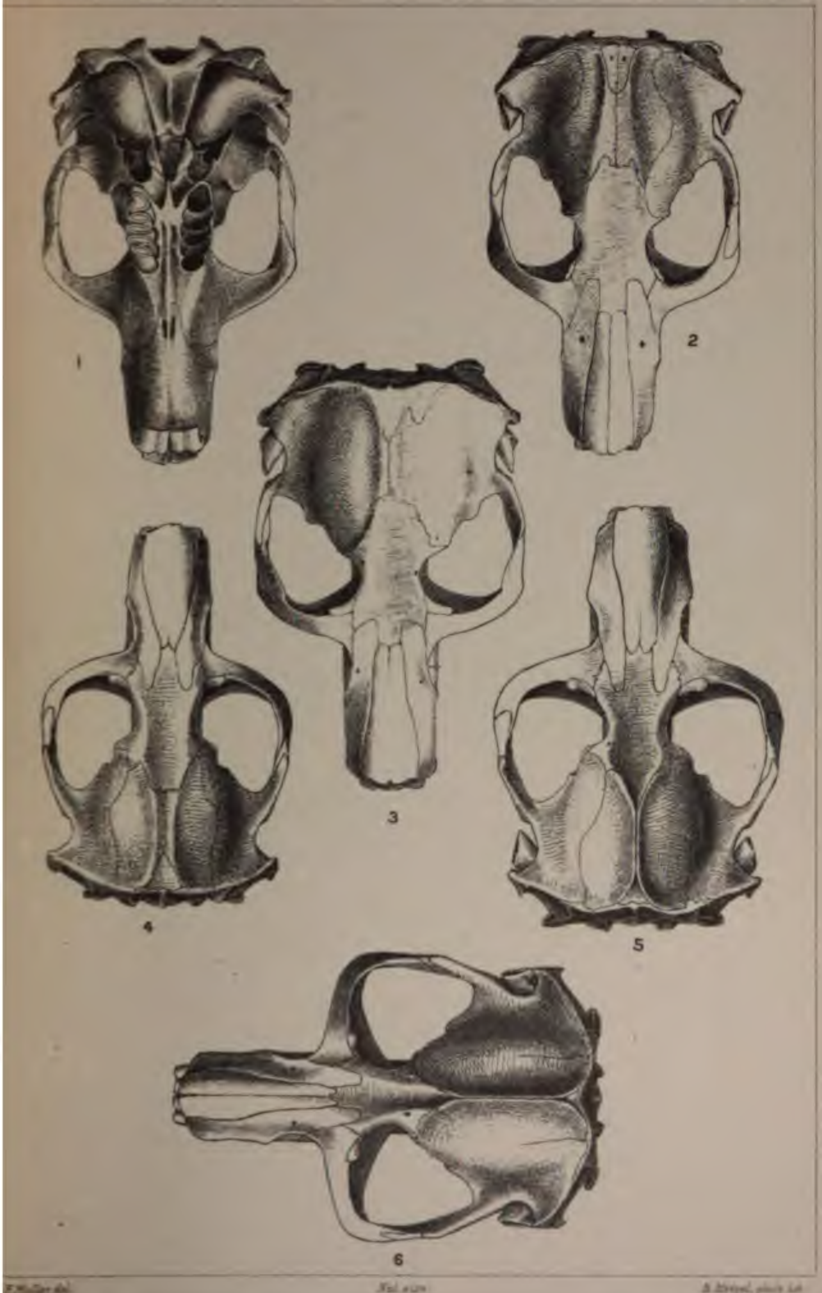
(All natural size.)

1 & 2. *Cratogeomys oreocetes* sp. nov. ♀ ad. Mount Popocatapetl, Mexico. *Type*
(No. 57963 U. S. Nat. Mus.)

3. *C. peregrinus* sp. nov. ♀ ad. Mount Iztaccihuatl, Mexico. *Type.*
(No. 57964 U. S. Nat. Mus.)

4 & 5. *C. estor* sp. nov. Las Vigas, Vera Cruz, Mexico.
(4 = No. 54306 ♀ ad. and 5 = 54308 ♂ ad. U. S. Nat. Mus.)

6. *C. perotensis* sp. nov. ♀ ad. Cofre de Perote, Vera Cruz, Mexico.
(No. 54299 U. S. Nat. Mus.)



1 & 2 ♀ ad. GEOMYS OREOCETES
4 ♀ & 5 ♂ G. ESTOR

3 ♀ ad. G. PEREGRINUS
6 ♀ ad. G. PEROTENSIS

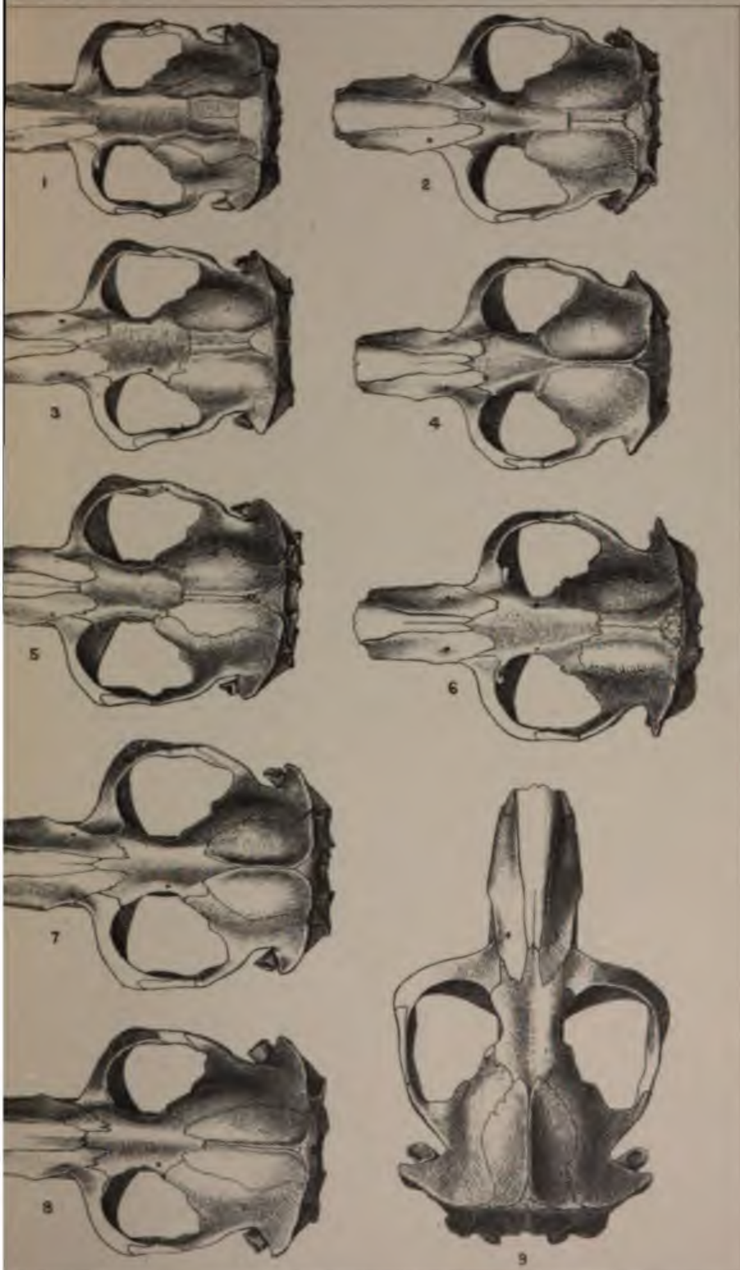
PLATE 9.

(All natural size.)

1. *Geomys arenarius* ♂ ad. El Paso, Texas.
   (No. 58339 U. S. Nat. Mus.)
2. *G. texensis* ♂ Mason, Texas.
   (No. 4161 Merriam collection.)
3. *G. attwateri* ♂ ad. Rockport, Aransas County, Texas.
   (No. 51382 U. S. Nat. Mus.)
4. *G. sagittalis* ♂ ad. Galveston Bay, Texas.
   (No. 44957 U. S. Nat. Mus.)

5 & 7. *G. lutescens* ♂ ad. Cherry County, Nebraska.
   (5 = 25640 ♂ yg. ad.; 7 = 25471 ♂ old, U. S. Nat. Mus.)

6. *G. breviceps* ♂ ad. Mer Rouge, Louisiana.
   (No. 46673 U. S. Nat. Mus.)
8. *G. bursarius* ♀ ad. Knoxville, Iowa.
   (No. 2024 Merriam collection.)
9. *G. bursarius* ♂ ad. Knoxville, Iowa.
   (No. 2625 Merriam collection.)



Nat. size

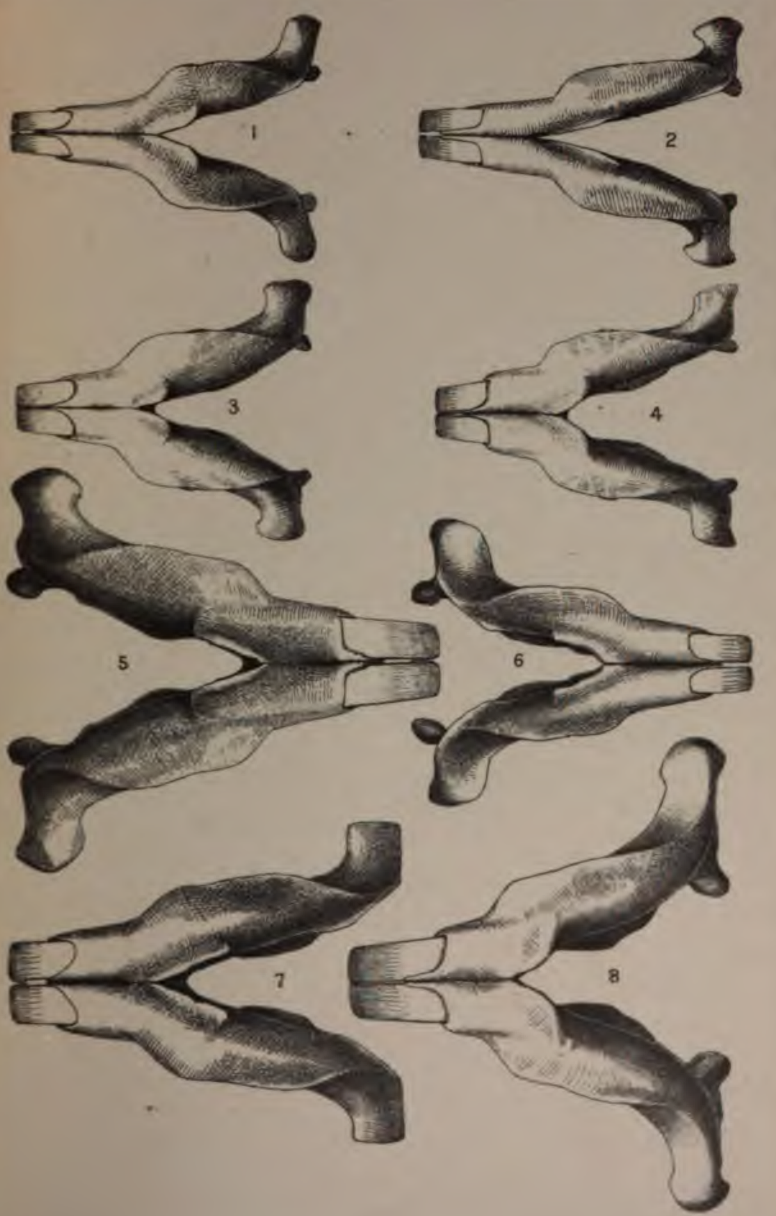
'S ARENARIUS ♂ ad. 2. G. TEXENSIS ♂ ad. 3. G. ATTWATERI ♂ ad. 4. G. SAGITTALIS ♂ ad.
& 7. G. LUTESCENS ♂ ad. 6. G. BREVICEPS ♂ ad. 8 ♀ ad. 9 ♂ ad. G. BURSARIUS

PLATE 10.

Under side of mandible.

(All natural size.)

1. *Geomys tuza floridanus* (Bachman). **San Mateo, Florida.**
   (No. 6511 ♂ Merriam collection.)
2. *G. tuza mobilensis* sp. nov. **Mobile Bay, Alabama.**
   (No. 46023 ♂ U. S. Nat. Mus.)
3. *Cratogeomys oreocetes* sp. nov. **Mount Popocatapetl, Mexico.**
   (No. 57963 ♀ U. S. Nat. Mus.)
4. *C. peregrinus* sp. nov. **Mount Iztaccihuatl, Mexico.**
   (No. 57964 ♀ U. S. Nat. Mus.)
5. *C. merriami* (Thomas). **Amecameca, Mexico.**
   (No. 57970 ♂ U. S. Nat. Mus.)
6. *Geomys bursarius* (Shaw). **Knoxville, Iowa.**
   (No. 2772 ♂ Merriam collection.)
7. *Macrogeomys dolichocephalus* sp. nov. **San Jose, Costa Rica.**
   (No. 36295 ♂ U. S. Nat. Mus.)
8. *Platygeomys gymnurus* Merriam. **Zapotlan, Jalisco, Mexico.**
   (No. 45611 ♂ U. S. Nat. Mus.)



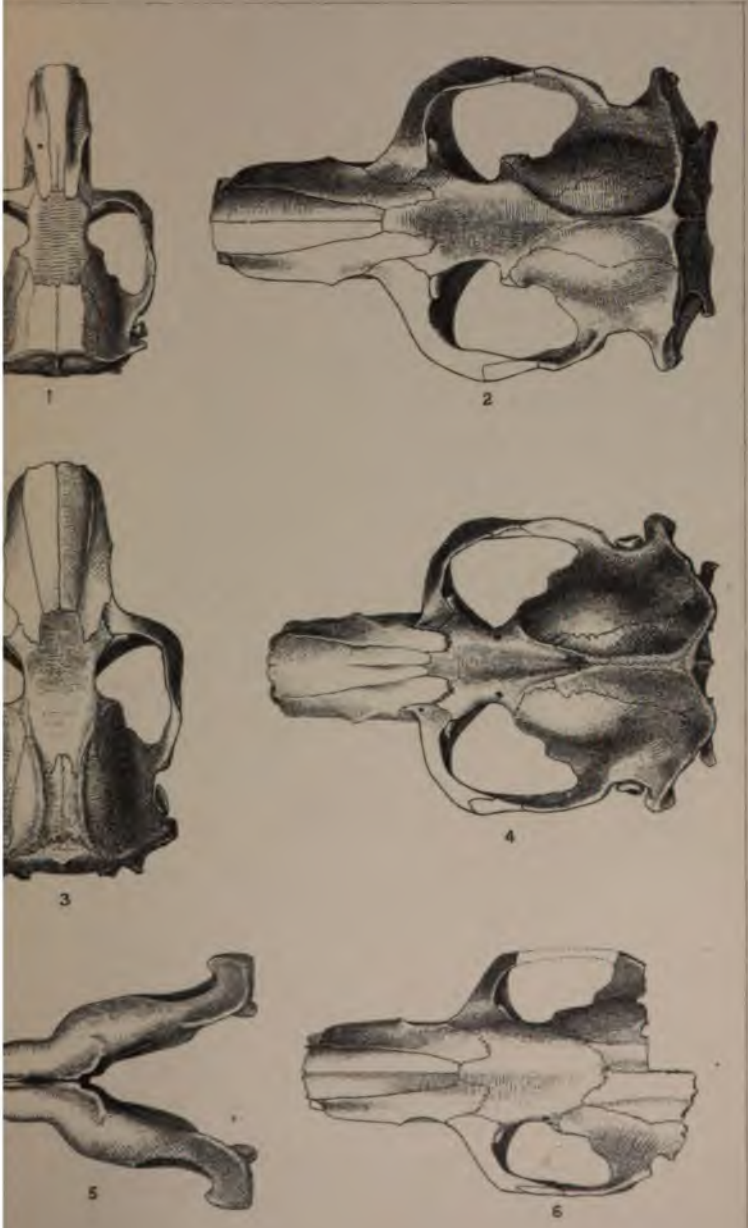
Nat. size

1 GEOMYS TUZA FLORIDANUS ♂ 2 G. MOBILENSIS ♂ 3. G. OREOCETES ♀ 4. G. PEREGRINUS ♀
5. G. MERRIAMI ♂ 6. G. BURSARIUS ♂ 7. G. DOLICHOCEPHALUS ♂ 8. G. GYMNURUS ♂

E 11.

ral size.)

1. *Pappogeomys bulleri* (Thomas). Sierra Nevada de Colima, Jalisco, Mexico.
(No. 45622 ♂ U. S. Nat. Mus.)
2. *Macrogeomys heterodus* (Peters). Costa Rica, Mexico.
(No. ——— ♂ U. S. Nat. Mus.)
3. *Heterogeomys costaricensis* sp. nov. Pacuare, Costa Rica.
(No. 22551, sex ?, U. S. Nat. Mus.) *Type.*
4. *Platygeomys fumosus* Merriam. Colima City, Mexico.
(No. 45211 ♂ U. S. Nat. Mus.)
5. *Orthogeomys latifrons* sp. nov. Guatemala.
(No. ———, sex ?, U. S. Nat. Mus.) *Type.*
6. *O. latifrons* (under side of mandible of same skull as 5.)



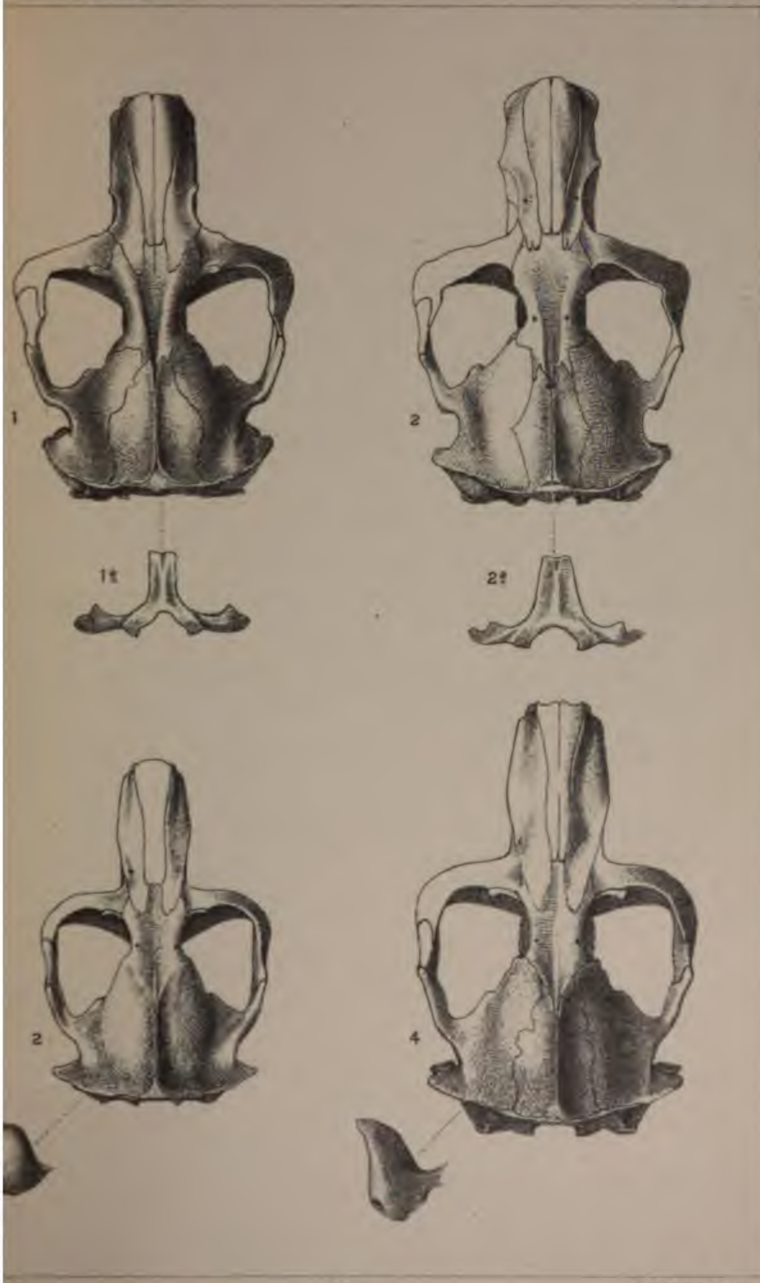
Nat. size. B. Meisel, photo lith.

OMYS BULLERI ♂ 2. G. HETERODUS ♂ 3. G. COSTARICENSIS
4. G. FUMOSUS ♂ 5 & 6. G. LATIFRONS

E 12.

(All natural size.)

1. *Cratogeomys castanops* (Baird). Las Animas, Colorado. (Type locality.)
   (No. 47368 ♂ U. S. Nat. Mus.)
   1a. Basioccipital of same specimen.
2. *Cratogeomys fulvescens* sp. nov. Chalchicomula, Mexico. (Type locality.)
   (No. 53498 ♂ U. S. Nat. Mus.)
   2a. Basioccipital of same specimen.
3. *Geomys personatus fallax* subsp. nov. Corpus Christi, Texas. *Type.*
   (No. 43845 ♂ ad. U. S. Nat. Mus.)
   3a. Left auditial bulla of same skull.
4. *Geomys personatus* True. Padre Island, Texas. (Type locality.)
   (No. 43294 ♂ U. S. Nat. Mus.)
   4a. Left auditial bulla of same skull.



del. Nat. size B. Meisel, photo. lith.

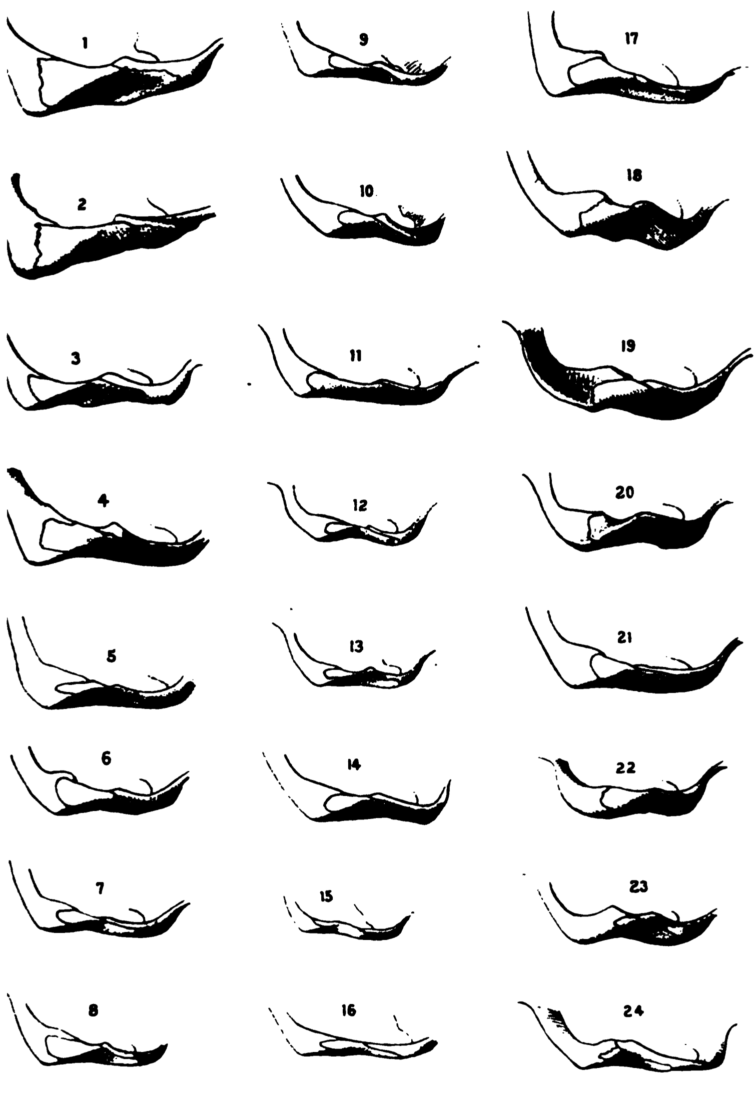
1. GEOMYS CASTANOPS 2. G. FULVESCENS
3. G. PERSONATUS FALLAX 4. G. PERSONATUS

PLATE 13.

Left zygoma, showing variations in jugal bone.

(All natural size.)

1. ***Platygeomys** tylorhinus* sp. nov. Patzcuaro, Mexico.
   (No. 47183 ♂ U. S. Nat. Mus.)
2. ***P. gymnurus*** Merriam. Zapotlan, Mexico.
   (No. 45611 ♂ U. S. Nat. Mus.)
3. ***P. planiceps*** sp. nov. Tula, Hidalgo, Mexico.
   (No. 55906 ♂ U. S. Nat. Mus.)
4. ***Cratogeomys** me* [illegible] ma, Mexico.
   (No. 50110 ♂ [illegible]
5. ***C. perotensis*** sp [illegible], Mexico.
   (No. 54295 ♀ [illegible]
6. ***C. estor*** **sp.** nov [illegible]
   (No. 54308 ♂ [illegible]
7. ***C. estor*** **sp.** nov [illegible]
   (No. 54306 ♀ [illegible]
8. ***C. oreocetes*** sp. [illegible] petl, Mexico.
   (No. 57963 ♀ [illegible]
9. *Geomys tuza* (Ord). [illegible]
   (No. 63842 ♂ **U. S. Nat. Mus.**)
10. *G. tuza floridanus* (Aud. and Bach.). **San Mateo, Florida.**
    (No. 6514 ♂ Merriam collection.)
11. *G. bursarius* (Shaw). Knoxville, Iowa.
    (No. 2624 ♂ Merriam collection.)
12. *G. texensis* sp. nov. Mason, Texas.
    (No. 4161 ♂ Merriam collection.)
13. *G. arenarius* sp. nov. El Paso, Texas.
    (No. 25015 ♂ U. S. Nat. Mus.)
14. *G. personatus* True. Padre Island., Texas.
    (No. 43294 ♂ U. S. Nat. Mus.)
15. *Pappogeomys bulleri* (Thomas). Sierra Nevada de Colima, Mexico.
    (No. 45618 ♀ U. S. Nat. Mus.)
16. *Orthogeomys latifrons* sp. nov. Guatemala. *Type.*
    (No. ——— U. S. Nat. Mus.)
17. *Cratogeomys castanops* (Baird). Las Animas, Colorado.
    (No. 47368 ♂ U. S. Nat. Mus.)
18. *Macrogeomys heterodus* (Peters). Costa Rica.
    (No. ——— U. S. Nat. Mus.)
19. *Macrogeomys dolichocephalus* sp. nov. San Jose, Costa Rica.
    (No. 36295 ♂ U. S. Nat. Mus.)
20. *Heterogeomys hispidus* (LeConte). Jico, Vera Cruz, Mexico.
    (No. 55313 ♂ U. S. Nat. Mus.)
21. *Heterogeomys torridus* sp. nov. Guatemala.
    (No. ——— ♂ U. S. Nat. Mus.)
22. *Macrogeomys cherriei* (Allen). Santa Clara, Costa Rica.
    (No. 661 im. Costa Rica Nat. Museum.)
23. *Macrogeomys costaricensis* sp. nov. Pacuare, Costa Rica.
    (No. 22551 im. U. S. Nat. Mus.)
24. *Zygogeomys trichopus* sp. nov. Nahuatzin, Michoacan, Mexico.
    (No. 50107 ♂ U. S. Nat. Mus.)



Nat. size

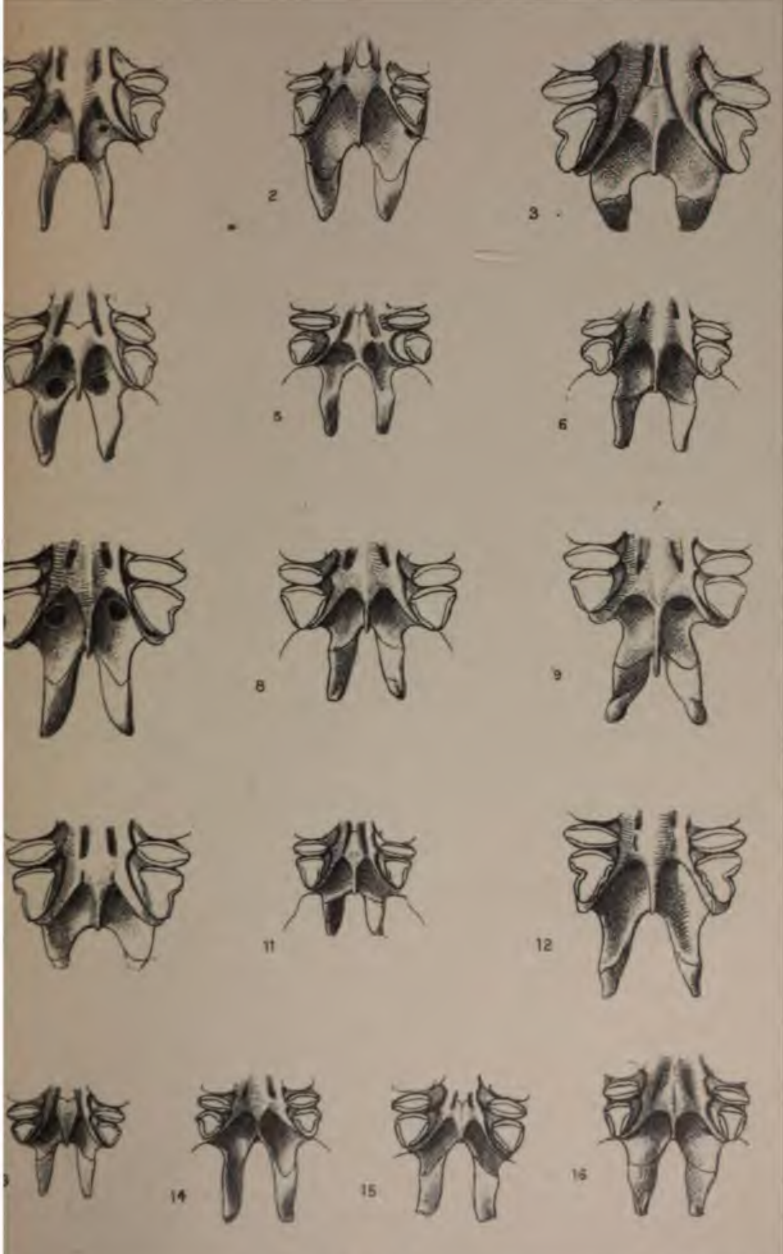
. GEOMYS TYLORHINUS ♂
. GYMNURUS ♂
. PLANICEPS ♂
. MERRIAMI ♂
. PEROTENSIS ♀
. ESTOR ♂
. *ESTOR* ♀
OREOCETES ♀
9. TUZA ♂
10. TUZA FLORIDANUS ♂
11. BURSARIUS ♂
12. TEXENSIS ♂
13. ARENARIUS ♂
14. PERSONATUS ♂
15. BULLERI ♀
16. LATIFRONS
17. CASTANOPS ♂
18. HETERODUS ♂
19. DOLICHOCEPHALUS ♂
20. HISPIDUS ♂
21. HISPIDUS. (form)
22. CHERRIEI
23. COSTARICENSIS
24. TRICHOPUS ♂

PLATE 14.

Posterior molars and palatopterygoids.

(All double natural size.)

1. *Zygogeomys trichopus* sp. nov. Nahuatzin, Michoacan, Mexico.
   (No. 50107 ♂ U. S. Nat. Mus.)
2. *Geomys bursarius* (Shaw). Knoxville, Iowa.
   (No. 2624 ♂ Merriam collection.)
3. *Macrogeomys heterodus* (Peters). Costa Rica.
   (No. —— U. S. Nat. Mus.)
4. *Geomys personatus* True. Padre Island, Texas.
   (No. 43294 ♂ U. S. Nat. Mus.)
5. *Geomys personatus fallax* subsp. nov. Corpus Christi, Texas.
   (No. 43292 ♀ U. S. Nat. Mus.)
6. *Cratogeomys castanops* (Baird). Las Animas, Colorado.
   (No. 47368 ♂ U. S. Nat. Mus.)
7. *Cratogeomys merriami* (Thomas). Lerma, Mexico.
   (No. 50110 ♂ U. S. Nat. Mus.)
8. *Platygeomys fumosus* Merriam. Colima, Mexico.
   (No. 45213 ♂ U. S. Nat. Mus.)
9. *Platygeomys planiceps* sp. nov. Volcan Toluca, Mexico.
   (No. 55906 ♂ U. S. Nat. Mus.)
10. *Macrogeomys costaricensis* sp. nov. Costa Rica. *Type.*
    (No. 22551 U. S. Nat. Mus.)
11. *Pappogeomys bulleri* (Thomas). Sierra Nevada de Colima, Jalisco, Mexico.
    (No. 45618 ♀ U. S. Nat. Mus.)
12. *Heterogeomys hispidus* (LeConte). Jico, Vera Cruz, Mexico.
    (No. 55017 ♀ U. S. Nat. Mus.)
13. *Geomys texensis* sp. nov. Mason, Texas.
    (No. 4168 ♀ Merriam Collection.)
14. *Geomys lutescens* Merriam. Woodward, Oklahoma.
    (No. 48566 ♂ U. S. Nat. Mus.)
15. *Geomys tuza mobilensis* sp. nov. Mobile Bay, Alabama.
    (No. 46025 ♂ U. S. Nat. Mus.)
16. *Geomys tuza floridanus* (Aud. and Bach.). San Mateo, Florida.
    (No. 6511 ♂ Merriam Collection.)

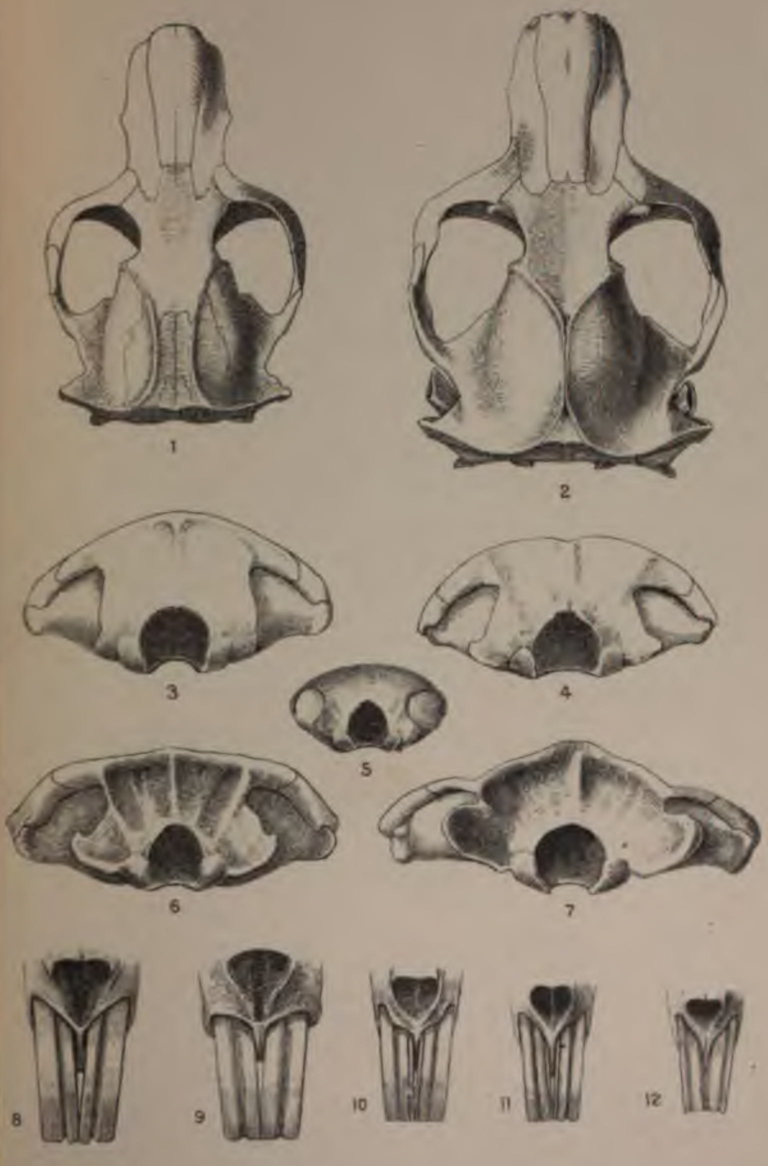


GEOMYS TRICHOPUS nob.	9. G. PLANICEPS nob.
BURSARIUS (Shaw)	10. COSTARICENSIS nob.
HETERODUS Peters	11. BULLERI Thomas
PERSONATUS True	12. HISPIDUS Le Conte
PERSONATUS FALLAX nob.	13. TEXENSIS nob.
CASTANOPS Baird	14. LUTESCENS Merriam
MERRIAMI Thomas	15. MOBILENSIS nob.
FUMOSUS Merriam	16. TUZA FLORIDANUS (Bachman)

PLATE 15.

(All natural size.)

1. *Macrogeomys cherriei* (Allen). Santa Clara, Costa Rica. (No. 664 im Museo Nacional de Costa Rica). *Type.*
2. *Heterogeomys torridus* sp. nov. Chichicaxtle, Vera Cruz, Mexico. (No. 63629 ♀ ad. U. S. Nat. Mus.). *Type.*
3. Occiput of *Macrogeomys dolichocephalus* sp. nov. San Jose, Costa Rica. (No. 36295 ♂ ad. U. S. Nat. Mus.). *Type.*
4. Occiput of *Heterogeomys hispidus* (LeConte). Jico, Vera Cruz, Mexico. (No. 55343 ♂ ad. U. S. Nat. Mus.)
5. Occiput of *Pappogeomys bulleri* (Thomas). Sierra Nevada de Colima, Jalisco, Mexico. (No. 45618 ♀ yg. ad. U. S. Nat. Mus.)
6. Occiput of *Cratogeomys merriami* (Thomas). Lerma, Mexico. (No. 50110 ♂ ad. U. S. Nat. Mus.)
7. Occiput of *Platygeomys gymnurus* Merriam. Zapotlan, Jalisco, Mexico. (No. 45611 ♂ ad. U. Nat. Mus.)
8. Upper incisors of *Macrogeomys dolichocephalus.*
9. Upper incisors of *Cratogeomys merriami.*
10. Upper incisors of *Zygogeomys trichopus.*
11. Upper incisors of *Geomys bursarius.*
12. Upper incisors of *Geomys tuza.*



1. GEOMYS CHERRIEI 2. G. TORRIDUS 3 & 8. G. DOLICHOCEPHALUS
4. G. HISPIDUS 5. G. BULLERI 6 & 9. G. MERRIAMI 7. G. GYMNURUS
10. G. TRICHOPUS 11. G. BURSARIUS 12. G. TUZA.

PLATE 16.

1 and 2. *Heterogeomys torridus* juv. Motzorongo, Mexico (No. 63643 U. S. National Museum).

Molariform teeth, showing deciduous premolars in situ; also unworn m 3, and immature pattern of crowns in m 1 and 2.

1. Left upper series.
2. Left lower series.

1*x*. Permanent upper premolar, uncovered to show unworn enamel crown.

a, Permanent premolar not yet in place; *b*, deciduous premolar; *c*, third upper molar; *d*, third lower molar.

3, 4, and 9. *Geomys bursarius* juv. Elk River, Minn. (No. 4909 Merriam coll.)

Molariform teeth, showing deciduous premolars in situ; also unworn m 3, and immature pattern of crowns in m 1 and 2.

3. Left upper series.
4. Left lower series.

4*x*. Transverse section of m_3 about three-fourths down, showing that the tooth is a single prism below, and that the enamel is confined to its posterior border.

9. Left lower series from outer side, showing relations of permanent and deciduous premolar, bilophiodont crown of m_3, and forms of m_1 and m_2 (which show the manner in which the change occurs from the double prism above to the single prism below).

a, Permanent premolar not yet in place; *b*, deciduous premolar; *c*, third upper molar; *d*, third lower molar.

5, 6, and 7. *Heterogeomys torridus* juv. (same specimen as in fig. 1).

Right upper premolar, showing unworn enamel cap and relations of enamel and cement. The cement bands are shaded.

5. Outer side of tooth.
6. Inner side.
7. Posterior face.

a, Outer cement band of anterior prism; *b*, postero-external cement band of posterior prism; *c*, inner cement band of posterior prism; *d*, inner cement band of anterior prism; *e*, lower end of enamel showing position of enamel organ.

8. *Macrogeomys heterodus* ad.

Right upper premolar, showing relation of cement bands (unshaded) to enamel (shaded) in mature tooth after the enamel cap [shown in figs. 5, 6, and 7] has worn off.

10 and 11. *Zygogeomys trichopus* juv. Nahuatzin, Mexico (No. 50104 U. S. Nat. Mus.).

Crowns of molariform series showing permanent enamel pattern and 'outer dentine' islands.

10. Left upper series.
11. Left lower series.

12 and 13. *Heterogeomys hispidus* ad. Motzorongo, Mexico.

Right upper premolar, after the enamel cap of the young tooth has worn off, showing permanent enamel pattern.

12. Outer side of the tooth (should be compared with 5, which shows same side of same tooth before the wearing down of the enamel cap begins).
13. Crown of same tooth.

a. Outer cement band of anterior prism.
b. Postero-external cement band of posterior prism.
Shaded bands show the enamel.

14–17. *Cratogeomys castanops* juv. Las Animas, Colorado.

14 and 15. A very young individual, but older than Nos. 1 and 4. The deciduous premolars have been shed, but the enamel caps of the permanent premolars (*a*) and the last true molars (m^3c and m_3d) have not yet worn down far enough to show the enamel pattern of the adult tooth (which may be seen in figs. 16 and 17). The crown of the last lower molar (*d*) is still a double prism.

16 and 17. Another immature individual of the same species, but enough older than 14 and 15 to show the permanent form and enamel pattern of the adult teeth.

18 and 19. *Geomys bursarius* im. Elk River, Minnesota.

Crowns of molariform series showing permanent enamel pattern.

18. Left upper series.
19. Left lower series.

20 and 21. *Macrogeomys cherriei* im. Santa Clara, Costa Rica. *Type*.

Crowns of molariform series showing permanent enamel pattern.

20. Left upper series.
21. Left lower series.

1, 2, 5, 6, 7, 12 & 13. HETEROGEOMYS HISPIDUS 3, 4, 9, 18 & 19. GEOMYS BURSARIUS
8. HETEROGEOMYS HETERODUS 10 & 11. ZYGOGEOMYS TRICHOPUS
14, 15, 16 & 17 CRATOGEOMYS CASTANOPS 20 & 21. HETEROGEOMYS CHERRIEI

PLATE 17.

(All natural size.)

Skulls seen from above; vault of cranium cut away, showing floor of brain case.

1. *Heterogeomys torridus.* Motzorongo, Vera Cruz, Mexico
2. *Zygogeomys trichopus.* Nahuatzin, Michoacan, Mexico.
3. *Geomys bursarius.* Portland, North Dakota.
4. *Platygeomys gymnurus.* Zapotlan, Jalisco, Mexico.
5. *Cratogeomys merriami.* Amecameca, Valley of Mexico.

Key to pl. 17.

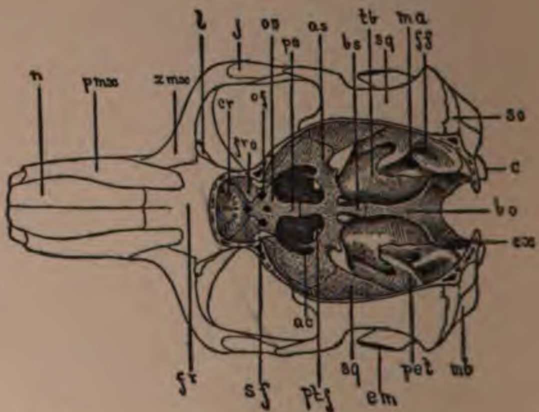


Fig. 9.—Young skull of *Cratogeomys merriami*, vault of cranium cut to show floor of brain case.

ac Anterior opening of alisphenoid can

as Alisphenoid bone.

bo Basioccipital.

bs Basisphenoid.

c Condyle of exoccipital.

cr Cribriform plate of ethmoid.

em External auditory meatus.

ex Exoccipital.

ff Floccular fossa.

fr Frontal.

fro Descending or orbital plate of frontal (the animal is so young that the plates of the two sides have not yet united below).

j Jugal.

l Lachrymal.

ma Meatus auditorius internus.

mb Mastoid bulla.

n Nasal.

of Optic foramen.

os Orbitosphenoid.

pet Petrous part of periotic.

pmx Ascending arm of premaxilla.

ps Presphenoid.

ptf Spheno-pterygoid fossa.

sf Apex of sphenoidal fissure.

so Supraoccipital.

sq Squamosal.

tb Superior face of tympanic or auditory bulla.

zmx Zygomatic root of maxilla.

TEROGEOMYS TORRIDUS sp. nov. 2. ZYGOGEOMYS TRICHOPUS sp. nov.
OMYS BURSARIUS (Shaw) 4. PLATYGEOMYS GYMNURUS (Merriam)
5. CRATOGEOMYS MERRIAMI (Thomas)

PLATE 18.

(All natural size.)

Vertical median longitudinal section of skull (mesethmoid and half of vomer in place).

1. *Geomys bursarius* ♂. Knoxville, Iowa.
2. *Zygogeomys trichopus* ♀. Nahuatzin, Michoacan, Mexico.
3. *Heterogeomys torridus* ♂. yg. ad. Motzorongo, Vera Cruz, Mexico
4. *Cratogeomys merriami* ♂. Tlalpam, Valley of Mexico.
5. *Platygeomys gymnurus* ♂. Zapotlan, Jalisco, Mexico.

Key to pl. 18.

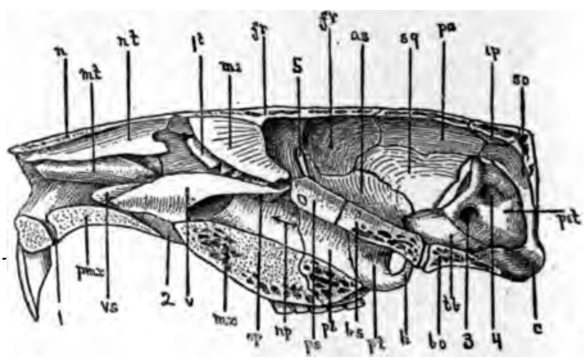
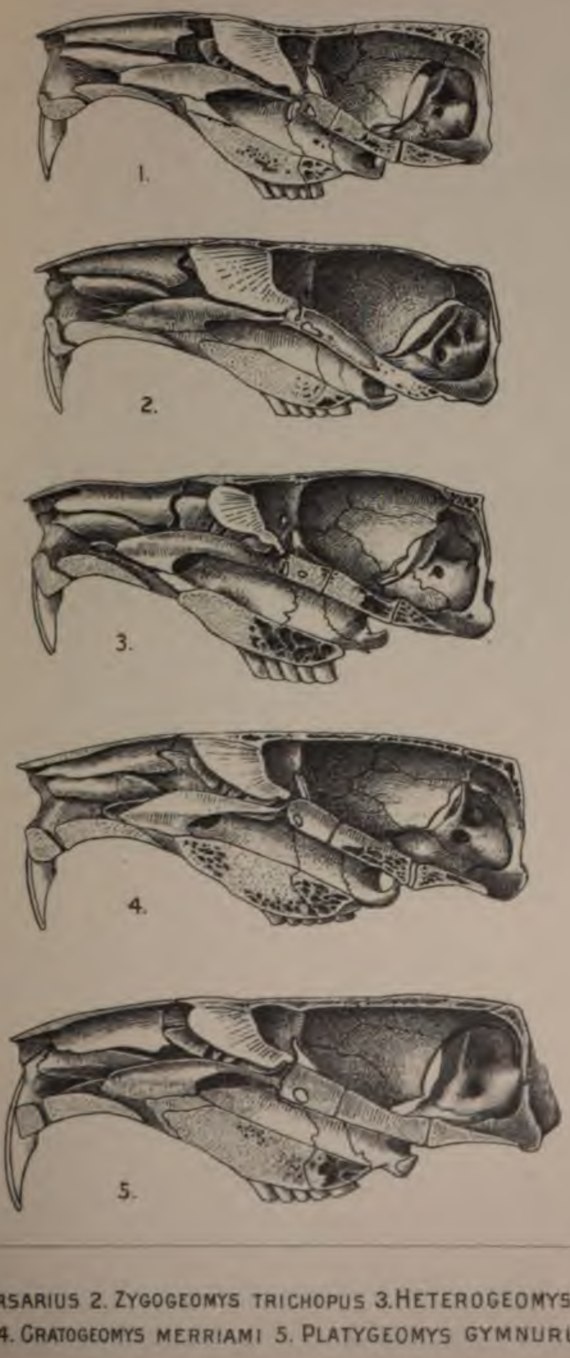


FIG. 7.—Longitudinal vertical median section of skull of *Cratogeomys merriami*, showing i of brain case and nasal chamber. Vomer and mesethmoid in place.

1 Anterior palatine foramen.
2 Incisive foramen.
3 Meatus auditorius internus.
4 Floccular fossa.
5 Upper part of sphenoidal fissure.
as Alisphenoid.
bo Basioccipital.
bs Basisphenoid.
c Condyle of exoccipital.
fr Frontal.
h Hamular process of pterygoid.
ip Interparietal.
me Mesethmoid plate.
mt Maxillo-turbinal.
mx Maxilla.
n Nasal.
nt Naso-turbinal.
op Lower border of os planum.
pa Parietal.
pet Petrous part of periotic capsule.
pl Palatine.
pmx Premaxilla.
ps Presphenoid.
pt Pterygoid.
so Supraoccipital.
sq Squamosal.
tb Tympanic bulla (antero-superio which alone appears within th case.)
v Vomer.
vs Vomerine sheath of maxilla.
1t First endoturbinal (Below and so behind it the anterior ends of ond, third, and fourth endot may be seen.)



del. B. Meisel, phot. lith.

MYS BURSARIUS 2. ZYGOGEOMYS TRICHOPUS 3. HETEROGEOMYS TORRIDUS
4. CRATOGEOMYS MERRIAMI 5. PLATYGEOMYS GYMNURUS

PLATE 19.

(All natural size.)

1. *Orthogeomys scalops* ♀ ad. Oaxaca, Mexico (skull from above).
2. *Orthogeomys scalops* ♀ ad. Same specimen (base of cranium).

3–7. Median longitudinal section of nasal chamber (vomer and mesethmoid removed) showing turbinated bones.

3. *Geomys bursarius* ♂. Knoxville, Iowa.
4. *Zygogeomys trichopus* ♀ … an, Mexico.
5. *Heterogeomys torridus* …
6. *Cratogeomys merriami* … Mexico.
7. *Platygeomys gymnurus* … Mexico.

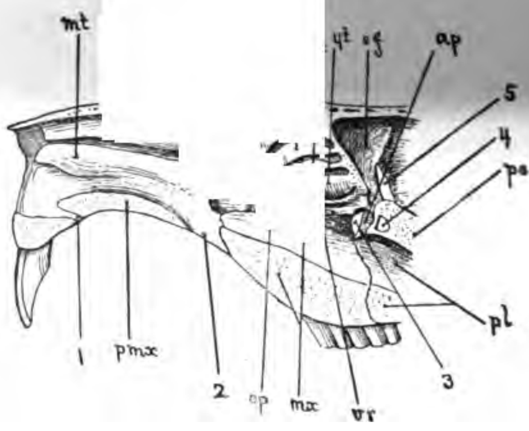
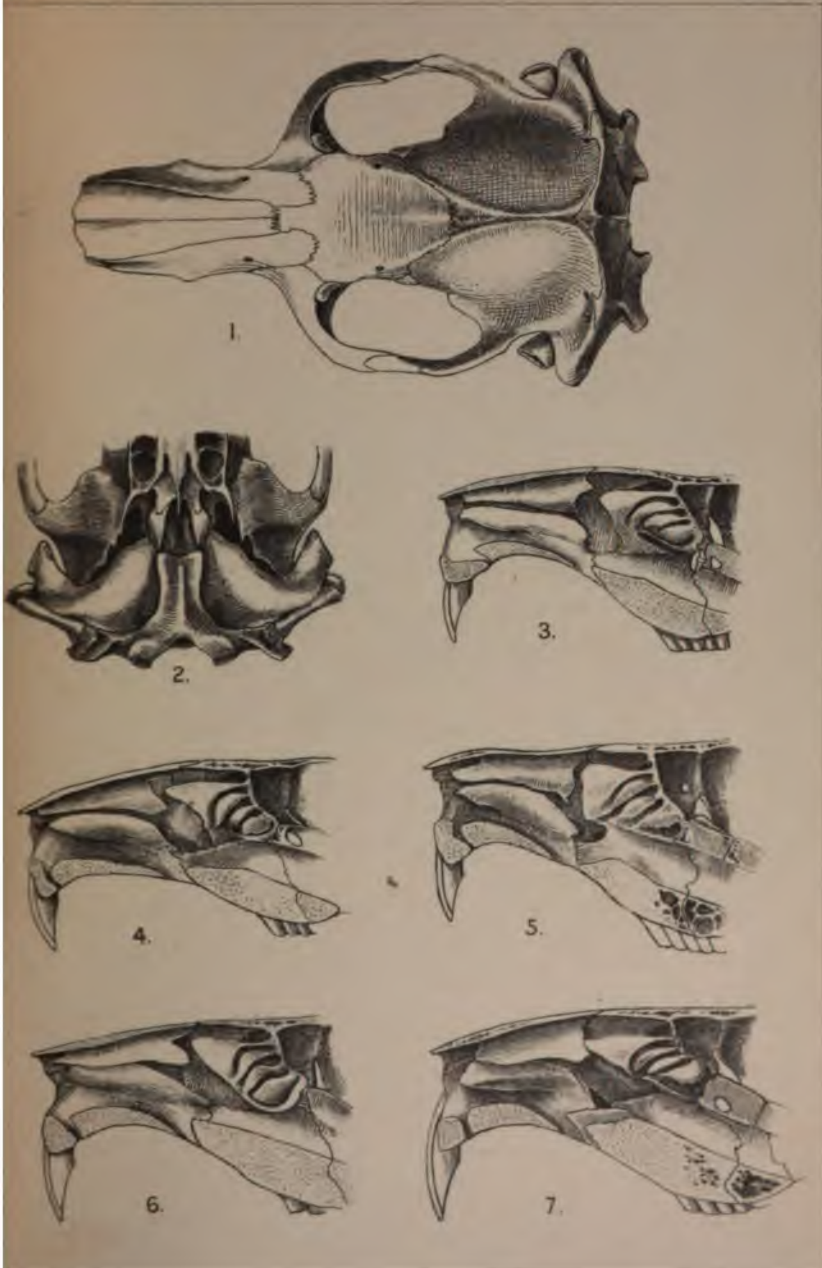


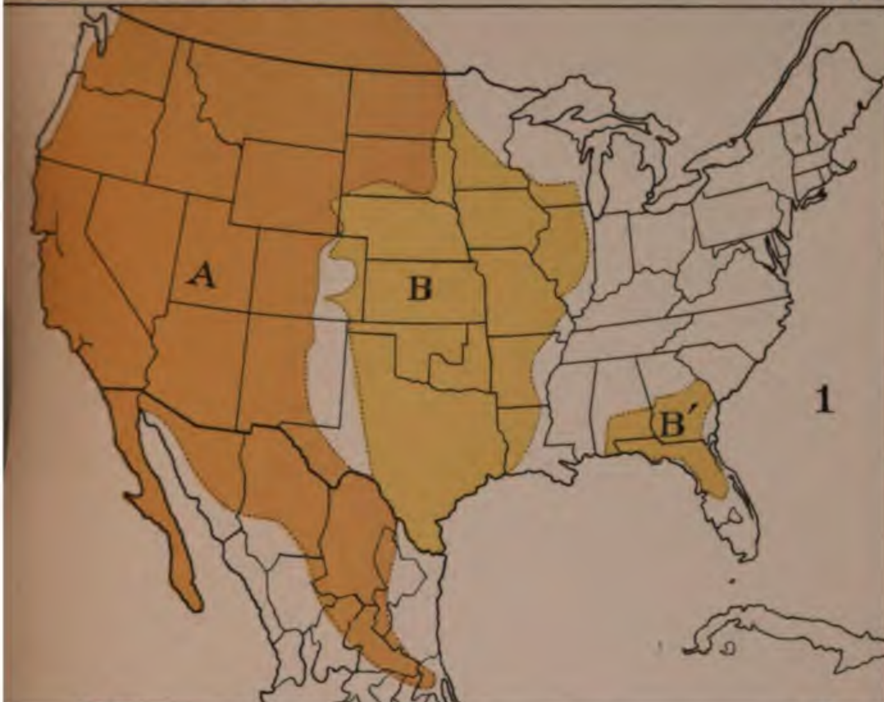
FIG. 10.—Longitudinal vertical median section of front part of skull of ***Geomys bursarius***. Mesethmoid and vomer removed to show turbinated bones.

- 1 Anterior palatine foramen.
- 2 Incisive foramen.
- 3 Vacuity in front of presphenoid (present in *Geomys bursarius* and *tuza* only. It is partly overlapped posteriorly by the ascending wing of the vertical plate of the palatine, *ap*.).
- 4 Presphenoid fenestrum. Present in all species.
- 5 Upper part of sphenoidal fissure
- *1t* First or superior endoturbinal.
- *2t* Second endoturbinal.
- *3t* Third endoturbinal.
- *4t* Fourth endoturbinal.
- *ap* Ascending wing of vertical plate of palatine
- *fr* Frontal
- *mt* Maxillo turbinal.
- *mx* Maxilla (the upper pointer rests on the maxillary surface of the narial passage, the lower on the sawed body of the bone).
- *n* Nasal.
- *nt* Naso turbinal
- *op* Os planum
- *pl* Palatine (the upper pointer rests on the palatine face of the narial passage, the lower on the sawed horizontal body of the bone)
- *pmx* Premaxilla
- *ps* Presphenoid
- … merine ridge of os planum (unites with the lateral wing of the vomer).



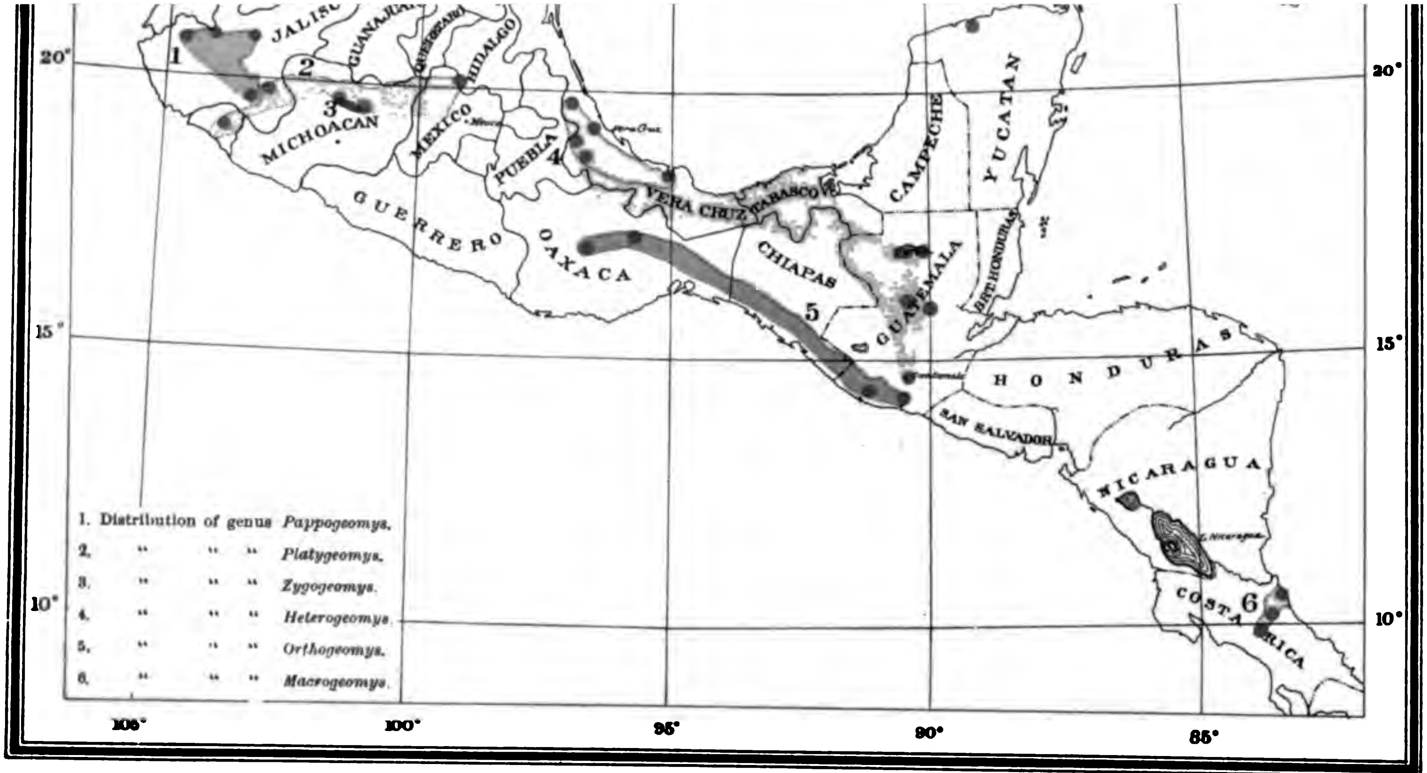
F. Müller del. H. Metzel, photo. lith.

& 2 ORTHOGEOMYS SCALOPS 3. GEOMYS BURSARIUS 4. ZYGOGEOMYS TRICHOPUS
5. HETEROGEOMYS TORRIDUS 6. CRATOGEOMYS MERRIAMI
7. PLATYGEOMYS GYMNURUS



MAP 1.—*A* DISTRIBUTION OF GENUS *THOMOMYS*.
B DISTRIBUTION OF GENUS *GEOMYS* (B = *G. bursarius* group; B′ = *G. tuza* group.)

MAP 2.—DISTRIBUTION OF GENUS *CRATOGEOMYS*.



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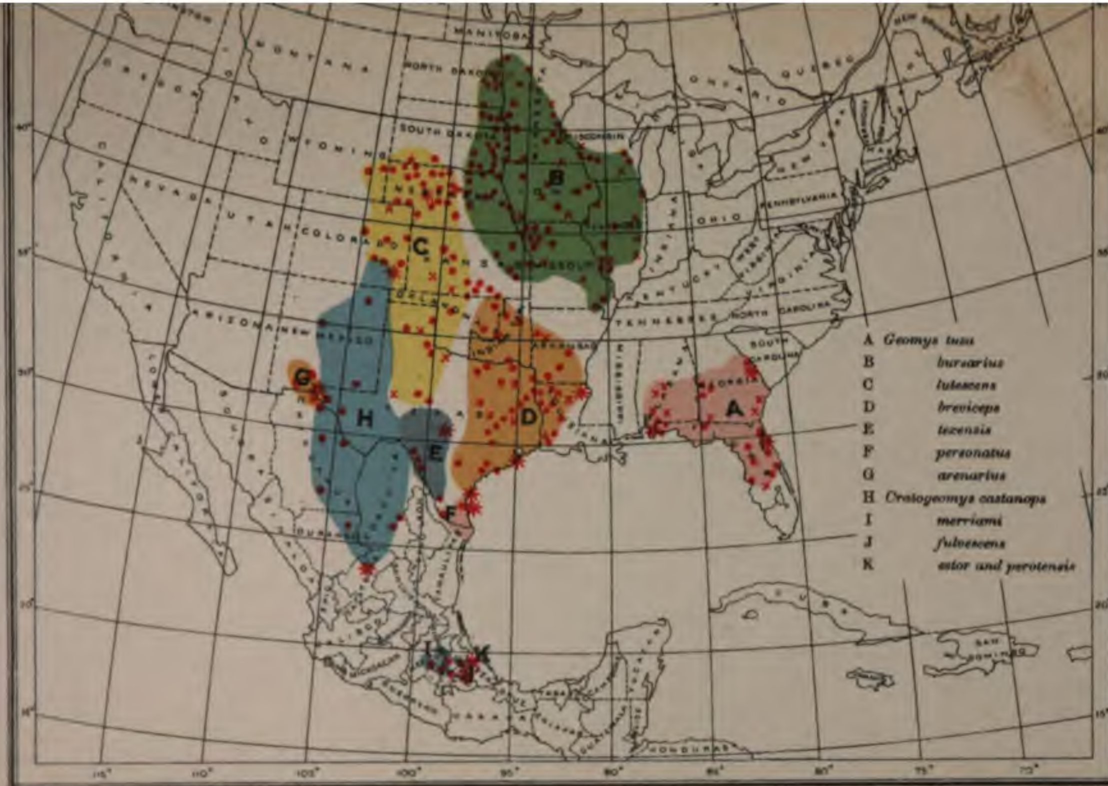

DISTRIBUTION OF THE SPECIES OF *GEOMYS* AND *CRATOGEOMYS*.

Spots (•) = specimens in collection. Crosses (X) = records. Stars (✱) = type localities of species and subspecies.

U. S. DEPARTMENT OF AGRICULTURE

DIVISION OF ORNITHOLOGY AND MAMMALOGY

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Revision of the Shrews of the American Genera Blarina and Notiosorex

C. HART MERRIAM

The Long-tailed Shrews of the Eastern United States

GERRIT S. MILLER, Jr.

Synopsis of the American Shrews of the Genus Sorex

C. HART MERRIAM

WASHINGTON

GOVERNMENT PRINTING OFFICE

1895

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C., August 31, 1895.

IR: I have the honor to transmit herewith, for publication as 10 of North American Fauna, three papers on North American ews, embracing results of investigations made by the Division of ithology and Mammalogy.

Respectfully,

C. HART MERRIAM,
Chief of Division of Ornithology and Mammalogy.

on. J. STERLING MORTON,
Secretary of Agriculture.

ILLUSTRATIONS.

PLATES.

SION OF THE SHREWS OF THE AMERICAN GENERA BLARINA AND NOTIOSOREX.

By C. Hart Merriam.

e Short-tailed Shrews of America belong to two genera—*Blarina* *Notiosorex*. Of the former, 14 alleged species have been described; e latter, only 2. Respecting the status and geographic ranges of species much confusion exists. In order to obtain authentic mation on these points the Department has made a special effort cure large series of specimens, and has sent trained collectors to of the original type localities of the forms that have been named. over, one of the field naturalists of the Division of Ornithology Mammalogy, Mr. E. W. Nelson, while conducting biological explora- in Mexico, has obtained a number of new species. As a result, ard of 600 specimens of the United States species and more than of the Mexican species are now before me.[1] Either the original s, or duplicate types obtained from the original type localities, of e United States and Mexican species have been examined. The lusions derived from a study of this material are embodied in the ent paper.

Genus BLARINA Gray, 1838.

ntal formula.—i, $\frac{4 \text{ or } 3}{2}$; c, $\frac{1}{0}$; pm $\frac{2}{1}$; m, $\frac{3}{3}$ = $\frac{9 \text{ or } 10}{6}$ ×, 2 = $\frac{18 \text{ or } 20}{12}$ = 32.

eth, 32 or 30; unicuspids, 5 or 4. First and second unicuspids large subequal or second largest; third and fourth much smaller; fifth te or absent; unicuspids (except minute posterior one) broad and ng a secondary cusplet on inner side; all the teeth heavily tipped dark chestnut, which usually reaches far down on the crowns. ium rather high and usually angular. No apparent external ears; short, always less than half the length of head and body; legs ; body usually stout and thickset (but more slender in the *parva* p).

HISTORY AND NOMENCLATURE.

r a long time the Short-tailed Shrews were included in the genus r. They were first separated by Gray in 1838 under the name *na*, proposed as a subgenus.[2] Four years later (1842) *Blarina* was d to full generic rank by Lesson.[3]

---

[1] addition to the specimens in the Department collection and my private col- n, I have had the privilege of examining about 100 belonging to Mr. Gerrit S. , jr.

[2] c. Zool. Soc. London, 1837 (June, 1838), 124.

[3] son, Nouv. Tableau Mammif., 1842, 89.

The first Short-tailed Shr
a naturalist were two spec
Major Long's expedition to t
ment in eastern Nebraska,
Omaha. It is a singular coi
the types of the largest and
later, of the two subgenera i
collected during the winter o
in 1823, the larger as *Sorex b*
It would have been far better
United States, for excepting
other names since proposed fa
Say's species.

Specimens of the larger spe
Ontario, were described by G
poides,[3] which name has been
as *brevicauda*. Other specim
Bachman in 1837, under the n
Bachman described as new tw
ereus,[5] both from South Caroli
and proves to be the same as
Bachman himself and also by
defined form, intermediate in
restricted to the Austroriparia
In 1857 Baird recognized

formed); *B. exilipes* (from Washington, Miss.) seems to be identical th *B. parva;* while *B. berlandieri* (from Matamoras, Mexico) is either distinct species or a subspecies of *parva.*

The status and relationships of *Blarina parva* have never been cor-ectly understood. As stated above the species was described by Say ore than seventy years ago from a specimen from eastern Nebraska. 1837 Bachman described a Shrew from South Carolina under the ame *Sorex cinereus.* He had great difficulty in separating it from ay's *S. parvus*, and "felt at one time a strong inclination to set it own as that animal."[1] In 1857 Baird admitted *S. cinereus*, and cor-ectly transferred it from *Sorex* to *Blarina.* But he took pains to state at he was unfamiliar with *Sorex parvus* of Say. Like Bachman, e suspected the identity of the two, for he says that *parva* "comes ery close to the *Sorex cinereus* of Bachman, and may possibly some day upplant its name."[2] In the same year (1857) Baird added another sup-osed species, which he called *Blarina exilipes.*[3] The type specimens ame from Washington, Miss.; and specimens from Spottsylvania ounty, Va., Brownsville, Tenn. [Texas?], St. Louis, Mo., and Dekalb ounty, Ill., were referred to the same species though those from the o latter localities were provisionally separated under the name *imius*, afterward adopted by Kennicott.[4]

After careful comparison of specimens from the type localities of *rva*, *cinerea*, and *exilipes*, I am unable to detect any characters by hich any one of them may be distinguished from the others. Baird mself was by no means positive of their distinctness. His remarks out *B. cinerea* have just been quoted; of *B. exilipes* he said: "I can t feel sure that the Mississippi specimens may not prove to be the ung of *S. cinereus.*"[5]

In 1861 Tomes described a small species from Coban, Guatemala, and med it *Sorex micrurus.*[6] This is the only member of the genus known om any point south of Mexico.

In 1877 Coues published an additional species, from Jalapa, Mexico, der the name *Blarina* (*Soriciscus*) *mexicana* (Baird MS).[7]

In 1891 Allen described a large *Blarina* which he named *B. costaric-sis*[8] because the type and only specimen was supposed to have been ken in Costa Rica; but it really came from the Upper Mississippi alley and is a typical *brevicauda.*[9]

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[1] Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, p. 375.
[2] Baird, Mammals N. Am., 1857, pp. 50, 56.
[3] Ibid, pp. 51–53.
[4] Ibid, p. 52; Quadrupeds of Illinois, 1858, p. 97.
[5] Ibid., p. 52.
[6] Tomes, Proc. Zool. Soc. London, 1861, 279. The name *micrura* is preoccupied and *picalis* is here substituted for it. (See p. 23, foot note.)
[7] Coues, Bull. U. S. Geol. and Geog. Surv., III, May 15, 1877, 652, 653
[8] Allen, Bull. Am. Mus. Nat. Hist., III, No. 2, April, 1891, 205, 206.
[9] See *postea*, under *Blarina brevicauda*, p. 14.

Subgenus *Blarina*:	
Blarina brevicauda (Say)	Blair, Nebraska.
carolinensis (Bach.)	Eastern South Carolina.
carolinensis peninsulæ nov.	Miami, Florida.
telmalestes sp. nov	Dismal Swamp, Virginia.
Subgenus *Cryptotis*:	
Blarina parva (Say)	Blair, Nebraska.
floridana sp. nov	Canaveral, Florida.
berlandieri Baird	Matamoras, Mexico.
tropicalis nom. nov	Coban, Guatemala.
soricina sp. nov	Tlalpam, Valley of Mexic
obscura sp. nov	Tulancingo, Hidalgo, Mex
mexicana Baird	Jalapa, Vera Cruz, Mexico
mexicana goldmani subsp. nov.	Mts. near Chilpancingo, G
mexicana peregrina subsp. nov.	Mountains near Oaxaca, C
mexicana machetes subsp. nov.	Mountains near Ozolotep
nelsoni sp. nov	Volcano of Tuxtla, Vera C
fossor sp. nov	Mount Zempoaltepec, Oa
alticola sp. nov	Mount Popocatapetl, Mex
magna sp. nov	Totontepec, Oaxaca, Mexi
nigrescens Allen	San Isidro, San José, Cos
orophila Allen	Volcano of Irazu, Costa I

Geographic distribution.—The genus *Blarina* is confi
America, where it ranges from the mountains of Central A
ward to the southern border of the Boreal zone in Canad
its highest development in the mountains of southern
same region in which the family *Geomyidæ* is represented
number of species and genera.[1] Although several of th

ley of Mexico, while not strictly a mountain form, is clearly an hoot from the tropical *B. tropicalis.*

n the United States the only species that passes beyond the Austral ion is *brevicauda.* It penetrates the southern edge of the Boreal e along the northern limit of its range, and ascends the higher ntains of North Carolina and Tennessee to the same zone.

n southern Mexico some of the high mountains have been so long ated that the species of *Blarina* inhabiting them have become dif- ntiated into local races or representative species. Thus the colo- s of the widely diffused *B. mexicana* type inhabiting mountains near xaca, Ozolotepec, and Chilpancingo, have developed peculiarities by ich each may be recognized from the others and also from the typical n from Vera Cruz. Similarly *B. alticola*, of Mount Popocatapetl other high mountains about the Valley of Mexico, is represented Mount Zempoaltepec, Oaxaca, by a closely allied species, *B. fossor.*

NUMBER OF SPECIMENS OF EACH SPECIES EXAMINED.

genus *Blarina:*		Subgenus *Cryptotis*—Continued.	
Blarina brevicauda	436	*Blarina mexicana*	110
carolinensis	89	*goldmani*	5
peninsulæ	7	*peregrina*	25
telmalestes	1	*machetes*	7
genus *Cryptotis:*		*nelsoni*	11
Blarina parva	114	*alticola*	10
floridana	4	*fossor*	5
berlandieri	8	*magna*	2
tropicalis	25	*nigrescens*	1
soricina	3	*orophila*	1
obscura	2		

Subgenus BLARINA Gray.

Blarina (subgenus of *Sorex*) Gray, Proc. Zool. Soc. London 1837 (June, 1838), 124. Type, *Sorex talpoides* Gapper = *S. brevicaudus* Say.

Blarina (full genus) Lesson, Nouv. Tableau Mammif., 1842, 89.

Brachysorex (subgenus) Duvernoy, Mag. de Zool., 2d ser., IV, 1842, 37-41. Type, *Sorex brevicauda* Say. (Specimen from New Harmony, Ind., and somewhat intermediate between *brevicauda* and *carolinensis.*)

Blaria Gray, List of Spec. Mammalia British Mus., 1843, XXI; List of Osteol. Spec. British Mus., 1847, XI, 23.

Talposorex Pomel, Archiv. Sci. Phys. and Nat. Genève, IX, 1848, 248. (Type, *Sorex carolinensis* Dekay = *S. brevicaudus* Say.) Not *Talpasorex* Lesson, 1827.

Galemys Pomel, Ibid., IX, 1848, 249 (in part; includes also *Crossopus* and *Pachyura*); not *Galemys* Kaup, 1829.

Anotus (subgenus) Wagner, Suppl. Schreber's Säugthiere, V, 1855, 550-551. Type, *Sorex carolinensis* Bach., from South Carolina.

iagnosis.—Teeth, 32; unicuspids, 5, the anterior 4 in two pairs; first second largest and subequal; third and fourth abruptly much smaller subequal; fifth minute (see fig. 1, *a* and *b*, p. 10). Basal lobe of lle incisor elongated anteroposteriorly. Brain case not arched ante- steriorly, highest at lambdoid suture; plane of occiput nearly flat.

Geographic distribution.—Broadly, the Austral region of the eastern half of the United States. One species (*B. brevicauda*) reaches the southern edge of the Boreal in southern Canada and the mountains farther south; another (*B. peninsulæ*) inhabits peninsular Florida.

FIG. 1.—Upper series of teeth of *Blarina carolinensis*. *a*. Outer side; *b*. Crowns.

Number of representatives.—Only 4 members of the subgenus *Blarina* are here recognized—the large *B. brevicauda* and *telmalestes*, and the smaller *carolinensis* and *peninsulæ*. Several slightly characterized local forms of *brevicauda* might be defined, but are not deemed worthy of recognition by name. *B. brevicauda* intergrades with *carolinensis*, and *carolinensis* with *peninsulæ*, leaving *telmalestes* as the only completely isolated form now known.

KEY TO SPECIES AND SUBSPECIES.

Size largest (total length about 120 mm. or more); brain case and under jaw strongly angular.
- Postero-internal lobe of molars narrow and elliptical................ *brevicauda*
- Postero-internal lobe of molars broad and rounded.................... *telmalestes*

Size smaller (length less than 100 mm.); brain case and under jaw less angular.
- Color dull plumbeous washed with brownish (hind foot about 12 mm.).. *carolinensis*
- Color slate black (hind foot more than 13 mm.)........................ *peninsulæ*

BLARINA BREVICAUDA (Say). Large Blarina.

Pl. 1, figs. 2–4; Pl. 2, figs. 1–4.

ORIGINAL REFERENCES.

1823. *Sorex brevicaudus* Say in Long's Exped. to the Rocky Mts., I, 1823, 164. (From near Blair, Nebr.)
1830. *Sorex talpoides* Gapper, Zool. Jour., V, 1830, 202, Pl. VIII. (From vicinity of Lake Simcoe, Ontario, Canada.)
1837. *Sorex dekayi* (Cooper) Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 377–381. (From New Jersey.)
1857. *Blarina angusticeps* Baird, Mammals N. Am., 1857, 47–48. (Deformed skull from Burlington, Vt.).
1891. *Blarina costaricensis* Allen, Bull. Am. Mus. Nat. Hist. New York, III, 1891, 205–206. (Supposed to be from Costa Rica, but really from the Upper Mississippi Valley. See *postea*, p. 12.)

SECONDARY REFERENCES.

Sorex brevicaudus Bach., Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 3; Aud. and Bach., Quadrupeds N. Am., III, 1854, 335–336.

Corsira (*Blarina*) *talpoides* Gray, Proc. Zool. Soc. London, 1837 (June, 1838), 12[?] [= *Sorex talpoides* Gapper = *S. brevicaudus* Say].

Blarina brevicaudata Lesson, Nouv. Tableau Mammif., 1842, 89.

Galemys (*Brachysorex*) *micrurus* Pomel, Archiv. Sci. Phys. et Nat., Genève, 1848, 24[?]

Blarina brevicauda Baird, Mammals N. Am., 1857, 42–45; Merriam, Mammals Adirondacks, 1884, 164–173 (habits).

Type locality.—West bank of Missouri River, near Blair, Nebr. (formerly Engineer Cantonment, 3 miles above mouth of Boyer River).

Geographic distribution.—Upper Austral and Transition zones, from western Nebraska and Manitoba eastward to the Atlantic Coast, penetrating a short distance into lower edge of boreal.

Habitat.—Chiefly deciduous woodlands and fields, where it lives in shallow tunnels that are often marked on the surface by little ridges.

General characters.—Size largest of the subgenus (total length about 125 mm.); skull largest and heaviest of the American *Soricidæ;* pelage glossy.

Color.—Sooty-plumbeous above, becoming ashy-plumbeous below, varying with the light; paler in summer; glossy in fresh pelage.

Cranial characters.—Skull large, massive, and angular (averaging 23 to 25 mm. in greatest length, and about 13 mm. in greatest breadth); occipital plane relatively large, nearly flat, and sloping strongly forward (not arched). The brain case presents the maximum of angularity known in the group, and is highest at the lambdoid suture. The ramus of the jaw is angular, being bent rather abruptly upward opposite the last molar. The upper lateral incisors contrasted with those of *carolinensis* are relatively narrower at base and slope more strongly forward; the first upper premolar (5th unicuspid) is usually visible from the outside.

Measurements.—Average of 8 specimens from near type locality: Total length, 127 mm.; tail vertebræ, 26.5 mm.; hind foot, 16.5 mm. Average of 31 specimens from Lake George, New York: Total length, 122 mm.; tail vertebræ, 26.5 mm.; hind foot, 15 mm. Average of 6 specimens from Marthas Vineyard, Massachusetts: Total length, 115 mm.; tail vertebræ, 22 mm.; hind foot, 13.4 mm.

General remarks.—*Blarina brevicauda* presents considerable variation in size and tint of color. The largest specimens are from western Nebraska, and those from eastern Nebraska (type locality) are larger than specimens from the Northern and Eastern States. From the type locality as a center, decrease in size takes place to the north, east, and south. Specimens from both sides of the Canadian boundary, between Manitoba and Lake Superior, are decidedly smaller than those from Nebraska, Iowa, and southern Minnesota, but larger than those from the Atlantic States. The smallest specimens I have seen are from eastern Massachusetts. Through the courtesy of Mr. Gerrit S. Miller, jr., I have been able to examine a number of skulls in his private collection from the following localities near the coast of that State: West Dedham, Wareham, Provincetown, Seekonk, Marthas Vineyard, and Nantucket. These skulls agree closely among themselves and average 22 mm. in greatest length (including incisors) and 12 mm. in breadth. Specimens from Nova Scotia, Ontario, New Hampshire, and Maine are larger, agreeing with those from the Adirondacks. The latter, however, are decidedly smaller than typical *brevicauda* from the Upper Mississippi Valley. This intermediate form was named *Sorex talpoides* by Gapper in 1830 (type from near Lake Simcoe, Ontario, Canada), and has been recognized as a distinct species by Baird (1857) and Miller (1893).[1] The impossibility of assigning logical geographic ranges to the resulting two forms, since the smaller *talpoides* surrounds the larger *brevicauda* on three sides (north, east, and south), and the additional fact that *talpoides* is intermediate between the large Nebraska *brevicauda* and the small form from the coast of New England are material obstacles to the recognition of *talpoides*, even as a subspecies. Furthermore, the species as a whole grades into *carolinensis* when it approaches the edge of the Austroriparian fauna; hence *talpoides*, being in this sense only an intergrade between *brevicauda* and *carolinensis*, is unworthy of recognition by name.

In color eastern specimens average slightly paler than those from the Mississippi Valley, but the seasonal difference is as great as the geographic. There is also much difference in the apparent color of the same specimen, according to the way it is held with reference to the light. A skin that is dusky or sooty when held away from the light and viewed from behind becomes almost ashy gray when looked at from the opposite direction. Winter specimens from Elk River, Minn., sometimes have a well-marked brownish-chestnut dorsal band.

Note on the so-called Blarina costaricensis.—Dr. J. A. Allen has kindly loaned me the type specimen of his *Blarina costaricensis*. It is in every respect a typical *Blarina brevicauda*, and doubtless came from some point in the Upper Mississippi Valley, probably Iowa. The skull and teeth agree perfectly with specimens from this State, where the collector, Mr. Cherrie, lived before he went to Costa Rica. The specimen had no label when it reached Dr. Allen. I do not doubt Mr. Cherrie's entire sincerity in thinking that it came from Costa Rica, but, as too well known, unlabeled museum specimens—particularly alcoholics—often have a way of becoming hopelessly mixed. Dr. Allen states that the skull received from Mr. Cherrie is larger than that of *B. talpoides* and the dentition heavier. These are precisely the ways in which true *brevicauda* from Iowa and Nebraska differs from its smaller representative of the Atlantic States, which has been called *talpoides*. I have just compared the skull of the type specimen of *costaricensis* with skulls from the type locality of *brevicauda* and find that the latter is somewhat larger and has equally heavy or slightly heavier teeth.

In clearing up the status of *costaricensis* an awkward geographical difficulty is also overcome, for the subgenus *Blarina* (with 32 teeth) is absolutely restricted to the United States. All of the specimens examined from Mexico and Guatemala, more than 200 in number, belong to the subgenus *Cryptotis* (with 30 teeth). It surpasses belief that a

[1] After examining the material on which the present paper is based Mr. Miller agrees with me that *talpoides* can not be recognized.

[c]olony of the northern *Blarina brevicauda* should exist in the tropics [o]f Costa Rica, separated from the normal range of its species by a [la]nd interval of several thousand miles—and an interval inhabited [e]xclusively by members of another subgenus.

Specimens examined.—Total number, 436, from the following localities:

Ontario: Rat Portage, Lake of the Woods, 6; Ottawa, 2.
Nova Scotia: Digby, 8.
North Dakota: Pembina, 1; Harwood, 1; Portland, 9.
Minnesota: Tower, Vermillion Lake, 3; Elk River, 25; Steele County, 4; Ortonville, 8; Two Harbors, 1.
Nebraska: Valentine, 2; Kearney, 2; Blair, 1; Columbus, 4.
Iowa: Council Bluffs, 8; Knoxville, 2.
Kansas: Onaga, 2.
Missouri: Kimmswick, 1.
Illinois: Dekalb, 2.
Michigan: Frankfort, 3; Ann Arbor, 5.
Ohio: Sandusky, 1; Garrettsville, 11; Canton, 1; Ellsworth, 1.
Pennsylvania: Drurys Run, 3; Nazareth, 1.
New York: Adirondacks, 8; Locust Grove, Lewis County, 77; Lake George, 33; Elizabethtown, 25; Alder Creek, 2; Syracuse, 2; Peterboro, 2; Troy, 1; Sing Sing, 4; Roslyn, Long Island, 1; Shelter Island, 1; Montauk Point, Long Island, 20.
New Hampshire: Ossipee, 10; Mount Washington, 1.
Maine: North Sebago, 1.
Massachusetts: Wilmington, 15; West Dedham, 3; Wareham, 25; Provincetown, 2; Seekonk, 2; Marthas Vineyard, 5; Nantucket, 1.
New Jersey: Tuckerton, 5.
Maryland: Baltimore, 1; Laurel, 1; Sandy Spring, 6; Locust Grove, 1.
District of Columbia: Washington, 35.
North Carolina: Roan Mountain, 16; Magnetic City, 5; mountains of Bun- County, 4; Old Richmond, 2.
Indiana: Richmond, 1.

BLARINA BREVICAUDA CAROLINENSIS (Bachman). Carolina Blarina.

Pl. 1; fig. 1; pl. 3, figs. 1, 5, 12.

Sorex carolinensis Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 366-370, Pl. XXIII, fig. 1. (From South Carolina.)
Aud. and Bach., Quadrupeds N. Am., II, 1857, 176-178, Col. Pl. LXXV.
Blarina carolinensis Baird, Mammals N. Am., 1857, 45-47.

Type locality.—Eastern South Carolina.

Geographic distribution.—Austroriparian fauna from the mouth of Chesapeake Bay to Arkansas.

Habitat.—Woodlands and open fields, living in tunnels and runways just beneath the surface.

General characters.—Size intermediate between *brevicauda* and *parva;* pelage glossy and velvety, as in *brevicauda;* hind foot small, as in *parva.*

Color.—Uniform dark sooty plumbeous, more or less tinged with brownish, especially in summer; indistinctly paler below.

Cranial and dental characters.—Compared with *B. brevicauda* the skull of *B. carolinensis* is much smaller and lighter (averaging 19 to 20 mm. in greatest length and 10 mm. in breadth); occipital plane more arched;

B. brevicauda, lacking the more accentuated features of t[illegible] the way of massiveness and angularity of the skull and lo[illegible] differs also in the lateral unicuspidate teeth. They are [illegible] vertical and the fifth is generally hidden when viewed from [illegible]

In geographic distribution it is strictly confined to the [illegible]rian fauna. It thus inhabits the southern half of the regio[illegible] by *B. parva*, and the two occur together in many localities.

Blarina carolinensis was described by Bachman in 1837, [illegible] the good fortune to escape synonyms. It is intermediate [illegible] not in characters, between the northern *Blarina brevicauda*, [illegible] it intergrades, and the southern *B. parva*, from which it di[illegible]nerically (having 32 instead of 30 teeth). Intergrades wit[illegible] are confined to a narrow strip just above the upper edge of [illegible] riparian zone. Such intergrades have been examined from C[illegible] Va.; Eubank, Ky.; Kimmswick, Mo., and the following pla[illegible]ern Indiana: Brookville, New Harmony, Vigo County, a[illegible] County. Specimens from Richmond, Ind., are nearer *brev*[illegible] *carolinensis*.

Specimens examined.—Total number, 97, from the followin[illegible]

Virginia: Belle Haven, 1; Cape Charles, 16; Kinsale, 1; Old Poi[illegible]
Kentucky: Eubank, 3; Hickman, 4.
Tennessee: Big Sandy, 1.
North Carolina: Raleigh, 39.
South Carolina: Columbia, 6; Lanes, 1; Georgetown, 1.
Georgia: Augusta, 1; Riceboro, 1.
Alabama: Greensboro, 1.
Mississippi: Washington, 10.

Color.—Upper parts uniform slate black, duller below; lacks the sepia-brown tint of *carolinensis.*

Cranial and dental characters.—Skull similar to that of *B. carolinensis*, but somewhat larger and heavier, with broader and more massive pterygoids. The upper molariform teeth are decidedly larger, heavier, and less emarginate posteriorly. The large upper premolar is broader, especially in front, and differs in form from that of *carolinensis.*

Measurements (taken in flesh).—Type: Total length, 97 mm.; tail vertebræ, 20 mm.; hind foot, 13.5 mm.

Average measurements of 6 specimens from peninsular Florida: Total length, 97 mm.; tail vertebræ, 18.5 mm.; hind foot, 13.5 (or 14) mm.

General remarks.—*Blarina peninsulæ* is the Tropical Florida representative of the Austroriparian *B. carolinensis.* It is common in the Everglades, where Mr. Loring secured four specimens on Miami River, on the east coast, and one at Everglade (near Chocoloskee), on the west coast. He also trapped one at Micco, Brevard County.

BLARINA TELMALESTES[1] sp. nov. Dismal Swamp Blarina.

Pl. 2, fig. 5.

Type from Lake Drummond, Dismal Swamp, Virginia. No. 71823, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected June 6, 1895, by A. K. Fisher. Original number, 1775.

Geographic distribution.—Dismal Swamp, Virginia.

General characters.—Similar to *B. brevicauda*, but more plumbeous in color; hind feet relatively longer; skull narrower; molariform teeth peculiar. Length of skull, including incisors, 24 mm.

Color.—Uniform dark plumbeous or slate gray above and below, slightly darker on the rump and nose; feet and tail blackish.

Cranial and dental characters.—Compared with its nearest relative, *Blarina brevicauda*, the skull of *B. telmalestes* is narrower, less massive, with less thickened anterior nares; the coloring on the teeth is paler and much less extensive, not reaching the crowns of the teeth except on the apices of the cusps; the large upper premolar and molars, particularly m^2, differ materially in shape, the postero-internal lobe being much more broadly rounded and the posterior concavity much deeper. The thickened angular cusp on the inner side is less marked and there is a much more pronounced and thickened rim running round the posterior lobe, defining a broad saucer-shaped depression. In actual size the skull is slightly shorter than specimens of *brevicauda* from Nebraska and western Iowa, but it is longer than those from New England and the Eastern States generally.

General remarks.—From the standpoint of geographic distribution *Blarina telmalestes* is by far the most interesting member of the genus. While closely resembling the large *B. brevicauda* in size and general

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[1] *Telmalestes*, from τέλμα, swamp + ληστής, robber.

appearance, it is completely surrounded by the small *B. carolinensis*. It is in effect therefore an insular form, like those inhabiting the summits of high mountains within the range of more southern species. Its semi-aquatic habits, necessitated by its watery environment, have led to the unusual development of the hind feet, and the distinctive character of the molars may have resulted from some peculiarity of food.

Measurements (taken in flesh).—Type specimen: Total length, 118 mm.; tail vertebræ, 28 mm.; hind foot, 16 mm. Average of 13 specimens from type locality: total length, 119.5; tail vertebræ, 26.4; hind foot, 16.

Subgenus CRYPTOTIS Pomel.

1848. *Cryptotis* Pomel, Archiv. Sci. Phys. and Nat. Genève, IX, Nov. 1848, 249. Type, *Sorex cinereus* Bach. (= *Sorex parvus* Say).

1877. *Soriciscus* Coues, Bull. U. S. Geol. and Geog. Surv., 1877, 649. "Type *Sorex parvus* Say or *S. cinereus* Bach."

Diagnosis.—Teeth, 30; unicuspids, 4, never in two pairs; fourth always smaller and usually minute; basal lobe of middle incisor a rounded cusp (pl. 3, figs. 2, 3, 13, 14). Brain case more or less arched, highest anterior to lambdoid suture; plane of occiput arched.

Geographic distribution.—Broadly, the less arid parts of the Austral region in Mexico, Guatemala, Costa Rica, and the eastern United States. One species (*parva*) pushes northward in the United States through the Upper Austral or Carolinian zone; one (*tropicalis*) reaches southward into the Tropical region of Mexico and Guatemala, and several ascend the mountains of Mexico into the Boreal.

Number of representatives.—The great majority of American Short-tailed Shrews belong to the subgenus *Cryptotis*. Sixteen species and subspecies are here recognized, contrasted with 4 of *Blarina* proper and 2 of *Notiosorex*. The subgenus attains its greatest development in the highlands of southern Mexico. The species may be roughly assembled in 4 groups: (1) The *parva* group, comprising *parva*, *floridana*, *berlandieri*, *tropicalis*, *soricina*, *orophila*, and *obscura* (the latter approaching the next); (2) the *mexicana* group, comprising *mexicana*, *goldmani*, *peregrina*, *machetes*, *nigrescens*, and *nelsoni*; (3) the *alticola* group, comprising *alticola* and *fossor*; and (4) the *magna* group, comprising, so far as known, the single species of that name.

It is of little consequence whether closely related forms are treated as species or subspecies. When intergradation is known or strongly suspected, or the degree of differentiation slight, the animals are classed as subspecies. In the case of two the smaller forms here accorded specific rank (*floridana* and *berlandieri*) it is not improbable that in each instance intergradation will be found with *parva* (but not with one another) when specimens are collected from intermediate localities.

KEY TO SPECIES AND SUBSPECIES.

Size very large (total length about 130 mm.; hind foot, 17 mm.) .... *magna*

Size medium or small (length 108 mm. or less):

1. Size medium (length, about 100 to 108 mm.; hind foot, 13 to 15 mm.):
    - 2. Large upper premolar deeply excavated posteriorly—
        - Large upper premolar with antero-internal angle well developed .... *alticola*
        - Large upper premolar with antero-internal angle broadly rounded off.. *fossor*
    - 2.[1] Large upper premolar not deeply excavated posteriorly—
        - 3. Total length, 106 mm. or more:
            - Hind foot about 15 mm.................................... *machetes*
            - Hind foot about 13 mm.................................... *nelsoni*
        - 3.[1] Total length, about 100 mm.:
            - 4. Unicuspidate teeth with strongly developed cusplet on inner side:
                - Brain case abruptly inflated above plane of rostrum .... *mexicana*
                - Brain case only slightly elevated above plane of rostrum .... *goldmani*
            - 4.[1] Unicuspidate teeth with inner cusplet feebly developed .... *peregrina*

1.[1] Size small (length less than 93 mm.; hind foot, 13 mm. or less).
- Size smallest; tail about 16 mm.; hind foot, about 10.5 mm......... *parva*
- Size larger; tail 19 mm. or longer; hind foot, 12 to 13 mm.:
    - Color sooty plumbeous; tail, about 25 mm.—
        - Large upper premolar deeply excavated behind............ *soricina*
        - Large upper premolar not deeply excavated behind......... *obscura*
    - Color ash gray or brown—
        - Total length, about 93 mm.; tail, about 25 mm............ *tropicalis*
        - Total length, less than 90 mm.; tail, 22 mm. or less—
            - Color iron gray to sepia brown........................ *floridana*
            - Color chestnut brown to ash brown.................. *berlandieri*

BLARINA PARVA (Say). Small Blarina.

Pl. 1, figs. 5, 6; pl. 3, figs. 2, 6, 13.

1823. *Sorex parvus* Say, in Long's Expedition to the Rocky Mountains, I, 1823, 164. (From near Blair, Nebr.)

1837. *Sorex cinereus* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, 1837, 373–376, Pl. XXIII, fig. 3. (From Goose Creek, 22 miles from Charleston, S. C.)

1857. *Blarina exilipes* Baird, Mammals N. Am., 1857, 51–53. (From Washington, Miss.)

1857. *Blarina eximius* Baird, Ibid, p. 52 (provisional name based on specimens from St. Louis, Mo. and Dekalb Co., Illinois.)

1858. Kennicott, Quadrupeds of Illinois, Report Commissioner of Agriculture for 1857, 1858, p. 97.

Type locality.—West bank of Missouri, near Blair, Nebr. (formerly Engineer Cantonment, 3 miles above mouth of Boyer River).

Geographic range.—Austral region of the eastern United States (including both the Austroriparian and Carolinian faunas) from Texas and eastern Nebraska eastward to the Atlantic. Not known from New York or New England.

teri (pl. 3, fig. 2); upper molars (m^1 and m^2) deeply excava
(pl. 3, fig. 13), thus differing from both *floridana* and *berlan*
are only slightly concave.

Measurements (taken in flesh).—Average of 13 specimens
locality (Blair, Nebr.): Total length, 79 mm.; tail vertebra
hind foot, 10.6 mm. Average of 25 from Raleigh, N. C.:[1] To
75 mm.; tail vertebræ, 16.4 mm.; hind foot, 10.6 mm. On
from Washington, Miss.: Total length, 80 mm.; tail vertebr
hind foot, 11 mm.

General remarks.—*Blarina parva* is the smallest of the S
Shrews known from the United States. Specimens from N
and from the coast region of southern South Carolina and G
somewhat larger than the typical form. Thus specimens f
erton, N. J., Georgetown, S. C., and Riceboro, Ga., are a
larger than those from Raleigh, N. C. But they agree with
in the extent and depth of color of the chestnut tips of the
in the deep excavation of the molars posteriorly, thus s
approach toward *B. floridana*.

Specimens examined.—Total number, 114, from the followin

Nebraska: Blair (type locality), 13.

Indiana: Brookville, 2; Irvington, 2; Terre Haute, 2; Vigo Count
County, 2.

Ohio: Garrettsville, 1.

New Jersey: Tuckerton, 3.

Maryland: Laurel, 1; Sandy Spring, 19.

District of Columbia: Washington, 1.

Virginia: Dismal Swamp, 1

BLARINA FLORIDANA sp. nov. Small Florida Blarina.

Pl. 1, fig. 7.

pe from Chester Shoal, 11 miles north of Cape Canaveral, Brevard County, Fla. No. [illegible], U. S. Nat. Mus., Department of Agriculture collection. Collected April 22, 1889, by Morris M. Green. Original number, 44.

Geographic distribution.—Peninsular Florida, south of latitude 29°. xact limits of range unknown.

Habitat.—Palmetto scrub.

General characters.—Similar to *B. parva*, but larger, with longer ull, whiter teeth, and larger molars, which are less deeply emargi- te posteriorly.

Color.—Upper parts in winter uniform iron gray, with a decided epper and salt' appearance; in summer, browner and more inclined sepia; under parts paler.

Cranial and dental characters.—Skull similiar to that of *parva*, but nger (18 instead of 16 mm.); last unicuspid visible from outside; lor of teeth paler and restricted to tips of cusps; posterior border f large molars (m^1 and m^2) only slightly concave, as in *berlandieri*, ot deeply excavated as in *parva*. The large molariform upper pre- olar has only a relatively shallow emargination behind, instead of e deep excavation of *parva;* and the notch on the front of the ner side is much smaller, and does not reach all the way down verti- ally (see pl. 3, fig.14).

Measurements.—Average of 2 specimens from type locality: Total ngth, 89 mm.; tail vertebræ, 22 mm.; hind foot, 12 mm.

General remarks.—It is interesting from a geographic standpoint to ote that in essential characters *Blarina floridana* agrees with *B. ber- andieri*, which latter animal likewise inhabits an extension of the ropical fauna into the United States. That the two are not connected round the Gulf of Mexico is evident from the fact that specimens rom southern Louisiana and Mississippi are very different, agreeing n the characters of their molars with true *parva*. Baird had a single pecimen of this species, of which he said: "A very badly preserved pecimen in alcohol from Indian River, Florida, exhibits some differ- nces, especially in the longer tail and larger size generally, includ- g the skull and feet. For the present, however, I shall refer it to . *cinerea*."[1]

Specimens examined.—Only 4 specimens of *floridana* have been exam- ed—2 from the type locality, Chester Shoal, 11 miles north of Canav- ral; 1 from Micco, and 1 from Gainesville.

[1] Baird, Mammals N. Am., 1857, 49

tively short; upper lateral incisors long and nearly vertical

Color.—Upper parts in summer ash brown, with a 'pepp appearance; tips of hairs in winter pelage almost chest parts grayish.

Cranial and dental characters.—The upper part of the ros to be a little more swollen in *berlandieri* than in *parva*, but impossible to separate the two by cranial characters. The l incisors (i^3 in particular), when unworn, are higher and m in *berlandieri*, as shown in pl. 3, fig. 3, contrasted with that 3, fig. 2. The best character I have discovered is the shape terior border of the upper molars. In *B. parva* the hinder l and m^2 is deeply excavated, much as in the large premolar; i *dieri* the premolar is much the same, but m^1 and m^2 are c concave behind. In young specimens the large size of the cuspid is usually marked, contrasted with *B. parva*.

General remarks.—I have compared a series of specimens fr ville, Tex., with Baird's types from Matamoras (on the Mex the river) and find no differences whatever. One of Baird' (No. 1794) is young and has unworn teeth. The lateral in and second unicuspids) are very long and rather slender, a of the second curves slightly backward. This is the speci by Dobson in his Monograph of the Insectivora, Part III, XXIV, fig. 7. It is closely matched by one of our spec Brownsville (No. 48810). In the other specimens the tip and consequently is not recurved. Whether *berlandieri* is subspecies of *parva* can not be determined from the materi

BLARINA TROPICALIS[1] Merriam. Tropical Blarina.

Pl. 1, fig. 8.

Corsira tropicalis Gray, Proc. Zool. Soc., London, 1843, 79. *Nomen nudum.*
Sorex micrurus Tomes, Proc. Zool. Soc., London, 1861, 279. (From Coban Guatemala.)
Blarina micrura Alston, Proc. Zool. Soc., London, 1877, 446; Biologia Centrali-Americana, Mammalia, 1880, 56, 57, Pl. V, fig. 2.
Blarina (Soriciscus) micrura Coues, Bull. U. S. Geol. and Geog. Surv. Terr., 638, footnote.

ype locality.—Coban, Guatemala (altitude about 4,400 feet).
eographic distribution.—Tropical fauna of western Guatemala and thern Mexico in States of (Chiapas?) Oaxaca and Vera Cruz.
eneral characters.—Size small, only a little larger than *B. parva* of United States.
olor.—Upper parts dull cinereous hair-brown, with 'pepper and t' appearance from admixture of black-tipped hairs; under parts y.
ranial and dental characters.—Skull small, but larger and more angu- than that of *parva* and decidedly broader than *floridana;* brain e essentially on plane of rostrum, with only a shallow sulcus between; der margin of palate slightly thickened on median line, suggest- a projection. Second unicuspid with inner cusplet prominent l projecting well inward; third unicuspid without inner cusplet; lariform teeth only slightly concave behind; large upper premolar h antero-internal angle prominent and without distinct step behind, inner border of the tooth more on a plane than usual.
easurements.—Mean of the two original type specimens from Coban, atemala, as measured by Tomes (converted into millimeters): Head l body, 60 mm.; tail, 23.6 mm.; hind foot, 11.4 mm. Average of 6 cimens from Pluma and Juquila, Oaxaca (measured in flesh): Total gth, 93 mm.; tail vertebræ, 25 mm.; hind foot, 12 mm.
eneral remarks.—In pushing northward in the tropical belt (tierra ente) of Vera Cruz to Catemaco (altitude, 1,000 feet), the Valley of zaba (altitude, 4,000 feet), and Jico (altitude, 4,800 feet) *Blarina trop- lis* undergoes certain changes in cranial and dental characters that shadow *B. soricina* of the Valley of Mexico (altitude, 7,600 feet). brain case becomes narrower and less angular, and the large upper

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[1] When *Sorex micrurus* Tomes (1861) was transferred to the genus *Blarina* it became occupied by *Galemys* (*Brachysorex*) *micrurus* Pomel (1848), which is a synonym of *rina brevicauda* (Say), and therefore is not available. No other name seems to been proposed for the species except *tropicalis* Gray, which is a *nomen nudum.* name, however, is peculiarly appropriate, the species being closely restricted to ical America; hence I here reinstate it to replace *micrurus*, but it will have to from the present paper. For *Galemys micrurus* Pomel, see Archiv. Sci. Phys. et Genève, IX, Nov. 1848, 249.

excavated. It resembles a specimen from Choapam, Oa
68555), except that the latter has the premolar less broad.

At Juquila, Oaxaca, Mr. Nelson found *Blarina tropicalis* li
logs in damp places; at Orizaba, Vera Cruz, they were in t
in the valley.

I have not seen the type of *B. tropicalis*, but have assum
specimens from Pluma and Juquila, Oaxaca, are sufficient
type form to be used as a standard of comparison for speci
at points farther north.

Specimens examined.—Total number, 25, from the followin
in southern Mexico:

State of Oaxaca: Pluma, 2; Juquila, 7; Choapam, 1; Tuxtepec,
State of Vera Cruz (specimens not typical): Catemaco, 1; Oriza
Jico, 8.

BLARINA SORICINA sp. nov. Sorex Blarina.

Pl. 1, fig. 9.

Type from Tlalpam, Valley of Mexico (altitude, 7,600 feet). No. 50762,
Nat. Mus., Department of Agriculture collection. Collected Dece
by E. W. Nelson. Original number, 3989.

General characters.—Similar to *B. tropicalis* in size a
appearance, but much darker, and with narrower, *Sorex*-like

Color.—Upper parts uniform sooty black; under parts
browner.

Cranial and dental characters.—Skull resembling that of
in size, but narrower, less angular, and more *Sorex*-like; b

...t at Jico, Vera Cruz, directly east of the Valley of Mexico, is much ...ser and more perplexing. The Jico animal agrees with true *tropi-...is* in coloration, but is more or less intermediate in cranial and dental ...aracters. It differs from *soricina* in smaller third and fourth unicus-...ds (the antero-posterior diameter of third much reduced), less deeply ...cavated premolar, and absence of excavation in first upper true ...olar.

...Mr. Nelson caught three of these small Blarinas under the banks of a ...eedy ditch close to the railway station at Tlalpam.

BLARINA OBSCURA sp. nov.

...pe from Tulancingo, Hidalgo, Mexico (altitude, 8,500 feet). No. 55634, ♀ yg. ad., U.S. Nat. Mus., Department of Agriculture collection. Collected August 27, 1893, by E. W. Nelson. Original number, 5377.

General characters.—Similar to *B. mexicana*, but smaller and decid-...ly paler.

Color.—Upper parts dark plumbeous, overlaid by sepia, becoming ...usky over the rump; under parts paler plumbeous, tipped with brown-...h; sides of nose dusky.

Cranial and dental characters.—Similar to *B. mexicana*, but much ...naller; rostrum and teeth nearly the same size in both, but postpalatal ...art of cranium much smaller and shorter; first, second, and third ...nicuspidate teeth broad at base, with well-developed inner cusplet; ...rge upper premolar only slightly concave behind and with antero-...ternal angle and cusp well marked.

Measurements (taken in flesh).—Type: Total length, 89 mm.; tail ver-...ebræ, 24 mm.; hind foot, 13 mm. Average of 2 specimens from type ...cality: Total length, 92 mm.; tail vertebræ, 25 mm.; hind foot, 13 mm.

General remarks.—Only two specimens of this new *Blarina* were ...btained by Mr. Nelson. They were caught in fir woods on the moun-...ins near Tulancingo, at an altitude of 8,500 feet, and were living in ...mall runways under the shelter of old logs.

BLARINA MEXICANA[1] Baird. Mexican Blarina.

Pl. I, fig. 11.

...77. *Blarina (Soriciscus) mexicana* (Baird MS.) Coues, Precursory Notes, Am. Insectivorous Mammals, May, 1877, 652–653. (From Jalapa, Mexico.)

...80. *Blarina mexicana* Alston, Biologia Centrali-Americana, Mammalia, Feb. 1880, 57.

Type locality.—Jalapa, Vera Cruz, Mexico. (No. $\frac{3525}{4435}$, U. S. Nat. Mus.)

Geographic distribution.—Tropical fauna of southeastern Mexico in ...tates of Vera Cruz and Oaxaca.

General characters.—Size medium (total length, about 100 mm.; hind ...ot, 13 mm.); coloration very dark.

[1] This animal is probably not the same as *Blaria mexicana* Gray, List of Osteo-...gical Specimens in British Museum, 1847, pp. XI and 23, from Coban, South America ...Coban, Guatemala. The latter is a *nomen nudum*.

and chestnut-tipped. Upper molariform teeth only s posteriorly. Chestnut tips of all the teeth strong and down.

Measurements.—Average of 22 specimens from J (practically the type locality): Total length, 99 mm. 27 mm.; hind foot, 13.3 mm.

General remarks.—So far as known, *Blarina mexic* widely dispersed species of the genus inhabiting south is common in damp oak forests on the mountains, wh resemble those of *Microtus*. The typical form is fro Cruz, near the southeastern base of the table-land. I nies from isolated mountains differ appreciably from several the differentiation has gone so far as to necess recognition, as in the forms here described under their *peregrinus*, and *goldmani*.

Concerning the habits of the typical form Mr. Nelson

This Shrew was rather common about Jico, and still more n lower border of the oak forest between the altitudes of 5,500 an Jico they were found mainly in *Arvicola* runways along the bor or along ditches bordering fields. They were also found with *I* *Sitomys* along the lower border of the oak forest. They live i grown up rankly with grass and weeds. In several places thei found threading their way among the plant stems and terminat at each end.

Specimens examined.—Total number, 110, from the ties in southern Mexico:

lete and without chestnut tip; molariform teeth more deeply concave posteriorly; m[2] with postero-internal lobe larger than antero-internal (reverse of *mexicana*).

Measurements (taken in flesh).—Type: Total length, 106 mm.; tail vertebræ, 31 mm.; hind foot, 15 mm. Average measurements of 20 specimens from type locality: Total length, 101.5 mm.; tail vertebræ, 30 mm.; hind foot, 14 mm.

General remarks.—This subspecies may be recognized most easily by the obsolescence of the postero-internal cusplet of the unicuspidate teeth. Of the forms described in the present paper, it is the least worthy of recognition by name. At the same time, the constancy of its characters and the geographic remoteness of the high mountains it inhabits from the home of typical *mexicana* seem to entitle it to stand. Mr. Nelson found it living in grassy meadows and forests on the mountains, where it had runways like those of the other species. Twenty-five specimens were secured at altitudes varying from 8,800 to 9,500 feet.

BLARINA MEXICANA GOLDMANI subsp. nov. Goldman's Blarina.

Type from mountains near Chilpancingo, Guerrero, Mexico (altitude, 10,000 feet). No. 70244, ♂ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected December 23, 1894, by E. W. Nelson and E. A. Goldman. Original number, 7231.

General characters.—Similar to *B. mexicana* in size and general appearance, but head and shoulders more plumbeous (less dusky) and under parts very much paler.

Color.—Upper parts sooty plumbeous, darkest on rump; bridge of nose darker than rest of head; under parts plumbeous, decidedly paler than upper parts.

Cranial and dental characters.—Skull similar to that of *mexicana*, but brain case flatter, only slightly elevated above plane of rostrum. Unicuspidate teeth narrower at base; large upper premolar broader behind antero-internal cusp and more excavated posteriorly.

Measurements (taken in flesh).—Type: Total length, 100 mm.; tail vertebræ, 28 mm.; hind foot, 13 mm. Average measurements of 5 specimens from type locality: Total length, 100 mm.; tail vertebræ, 28.5 mm.; hind foot, 13.2 mm.

General remarks.—*Blarina goldmani* is closely related to *B. mexicana*, differing chiefly in paler under parts, flatter brain case, and slight dental characters. The close resemblance is surprising, in view of the remoteness of the type localities of the two and the great difference in altitude at which they live. The 5 specimens on which the present species is based were collected in damp thickets among fir trees at an elevation of 10,000 feet.

BLARINA MEXICANA MACHETES subsp. nov. Ozolotepec Blarina.

Type from mountains near Ozolotepec, Oaxaca (altitude, 10,000 feet). No. 71456, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected March 28, 1895, by E. W. Nelson and E. A. Goldman. Original number, 7723.

General characters.—Similar to *B. mexicana* in color and general appearance, but somewhat larger, with decidedly larger fore and hind feet, and peculiar dental characters.

Color.—Dusky or sooty black; bridge of nose darker than rest of face; under parts dark in fresh pelage, but more or less ashy in old pelage.

Cranial and dental characters.—Skull similiar to that of *mexicana*, but slightly larger; brain case less elevated above slope of rostrum; unicuspids with inner cusplet smaller and not chestnut tipped; large upper premolar longer, broader, and more excavated posteriorly, with antero-internal angle and cusp less developed; molars larger and more concave behind; lower molars larger.

Measurements (taken in flesh).—Type: Total length, 104 mm.; tail vertebræ, 31 mm.; hind foot, 15 mm. Average measurements of 7 specimens from type locality: Total length, 108 mm.; tail vertebræ, 30.5 mm.; hind foot, 15 mm.

General remarks.—This is a well-marked form of the *mexicana* series, and it comes from the southernmost locality from which any member of the group has thus far been obtained. Mr. Nelson found it among willows in a cold boggy place in the woods, on the north slope of the mountains, at an altitude of 10,000 feet, where its runways were conspicuous and where 7 specimens were obtained.

BLARINA NELSONI sp. nov. Nelson's Blarina.

Type from Volcano of Tuxtla, Vera Cruz, Mexico (altitude, 4,800 feet). No. 65437, ad., U. S. Nat. Mus., Department of Agriculture collection. Collected May 13, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6253.

General characters.—Similar to *B. mexicana* in size, general appearance, and color, perhaps even darker; differs in important cranial and dental characters.

Color.—Uniform sooty brown.

Cranial and dental characters.—Compared with *B. mexicana* the skull is larger and heavier; brain case larger, flatter, and not abruptly elevated above plane of slope of rostrum; interpterygoid fossa much broader. Molariform teeth decidedly broader and heavier; large upper premolar very broad posteriorly, but not excavated, its antero-internal angle and cusp well developed and followed by a sulcus, behind which the tooth immediately broadens. Unicuspidate teeth with inner cusplet nearly obsolete. In some respects the skull resembles *alticola* more than *mexicana;* it differs conspicuously from both in the broad and short interpterygoid notch. The upper molariform teeth differ from those of e *alticola* series in lacking the posterior excavation. The obsoles-nce of the inner cusplet of the unicuspids is even more complete an in *alticola*.

Measurements (taken in flesh).—Type: Total length, 110 mm.; tail ertebræ, 31 mm.; hind foot, 14 mm. Average measurements of 11 pecimens from type locality: Total length, 106 mm.; tail vertebræ, 9 mm.; hind foot, 13.3 mm.

General remarks.—The peculiarities of *Blarina nelsoni* may be briefly ummed up as follows: In external appearance it is hardly distinguish-ble from *B. mexicana;* the skull is larger and more closely resembles *. alticola*, but differs from both in the remarkably broad and short ostpalatal notch; the molariform teeth resemble those of *mexicana*, hile the unicuspidate teeth resemble those of *alticola*. So far as nown, the species is restricted to the isolated volcano of Tuxtla, here Mr. Nelson secured a dozen specimens. Mr. Nelson states that t is common in the forest on the mountain and ranges up to the extreme ummit, at an altitude of 5,400 feet. Like most of the other species, it nakes trails or runways under the shelter of roots and logs.

BLARINA ALTICOLA sp. nov. Popocatepetl Blarina.

ype from Mount Popocatepetl, Mexico (altitude, 11,500 feet). No. 52047, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected February 25, 1893, by E. W. Nelson. Original number, 4396.

Geographic distribution.—Higher slopes of Mount Popocatepetl and e mountains near Salazar and Ajusco, south of the City of Mexico rom 9,500 to 12,000 feet altitude).

General characters.—Size, medium, slightly larger than the *mexicana* roup; hind foot decidedly larger than that of *mexicana* or any other lexican species except *magna*.

Color.—Sooty plumbeous, decidedly paler on the belly, but without ne of demarcation.

Cranial and dental characters.—Skull similar to that of *mexicana*, but omewhat larger; brain case narrower and less sharply angular later-lly. Molariform teeth much larger and much more deeply excavated osteriorly, especially the large upper premolar, which tooth has the ntero-internal angle and cusp strongly developed; unicuspidate teeth ith thicker and blunter crowns.

Measurements (taken in flesh).—Type: Total length, 107 mm.; tail ertebræ, 26 mm.; hind foot, 15 mm. Average measurements of 5 pecimens from type locality: Total length, 104 mm.; tail vertebræ, 5 mm.; hind foot, 15 mm.

General remarks.—This species is very distinct from any thus far dis-overed except the *B. fossor* here described, which is closely related. xternally it resembles *Blarina brevicauda* of the United States, but is naller. It differs from the *mexicana* series in larger size, much larger ind foot, and in the dental characters just mentioned. It is a high mountain form living in damp, sheltered places on wooded hi under sacaton grass, at an altitude of 9,500 to 12,000 feet.

Specimens examined.—Total number, 10, from the following all in the State of Mexico: Mount Popocatepetl, 5; Salazar, Peak, 1; north slope of volcano of Toluca, 1.

BLARINA FOSSOR sp. nov. Zempoaltepec Blarina.

Type from Mount Zempoaltepec, Oaxaca, Mexico (altitude, 10,500 feet) ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collec 1894, by E. W. Nelson and E. A. Goldman. Original number, 6419.

Geographic distribution.—Higher slopes of Mount Zempoalt 8,200 to 10,500 feet altitude).

General characters.—Similar to *B. alticola* in size, large and general characters, but darker, and with differences in teeth.

Color.—Sooty plumbeous, becoming slightly paler anterio nose darker than rest of head; under parts indistinctly pal a slight brownish cast.

Cranial and dental characters.—Compared with *B. alticol* it is closely related, the skull is slightly shorter. The len molariform series is essentially the same, but the unicuspi shorter. Upper molariform teeth narrower; large uppe decidedly different in form, lacking the antero-internal angl completely rounded off, leaving the tooth much narrower in that of *alticola*.

Measurements (taken in flesh).—Type: Total length, 111 vertebræ, 29 mm.; hind foot, 15 mm. Average of 5 speci type locality: Total length, 108 mm.; tail vertebræ, 29 mm.; 14.6 mm.

General remarks.—On Mount Zempoaltepec Mr. Nelson specimens of this new *Blarina*, 25 of *B. mexicana*, and 1 of *I*

BLARINA MAGNA sp. nov. Big Mexican Blarina.

Pl. 1, fig. 10.

Cranial and dental characters.—Skull resembling that of *Blarina evicauda* in size and general appearance, but narrower, with longer strum and more arched brain case. The brain case in profile is ongly convex, and the highest point is near junction of posterior and ddle thirds. Unicuspidate teeth narrow, with inner cusplet very all. Molariform teeth not at all excavated posteriorly, and without erspaces. Large upper premolar short and broad, with antero-ernal angle broadly rounded off.

Measurements (taken in flesh).—Type: Total length, 134 mm.; tail rtebræ, 42 mm.; hind foot, 17 mm.

General remarks.—*Blarina magna*, owing to its very large size, does t require comparison with any known species. The tail is very long a *Blarina* (45 percent of the length of head and body). A speci-n from Mount Zempoaltepec lacks the chestnut-brown wash on the roat. Mr. Nelson states that the runways of this large *Blarina* are nspicuous in the dense, damp oak forest of the mountains. Only o specimens were obtained.

Average measurements of the species of Blarina.

[All measurements are in millimeters and from fresh specimens.]

Name of species.	Locality.	Total length.	Tail vertebræ.	Hind foot.	Number of specimens.
ina brevicauda	Council Bluffs, Iowa	127	26.6	16.5	8
	Lake George, New York	121.5	26.7	14.8	31
	Locust Grove, Lewis County, N. Y.	121	25	14.6	58
telmalestes	Dismal Swamp, Virginia	119.5	26.4	16	13
carolinensis	Columbia, S. C.	99.5	20.6	12.5	6
	Raleigh, N. C.	93.3	20.3	11.6	63
	Washington, Miss	94	20	12.2	9
peninsulæ	Everglades of Florida	96.8	18.5	13.5	6
parva	Blair, Nebr	79	16	10.6	13
	Raleigh, N. C	75.6	17	10.1	25
floridana	Canaveral, Fla	89	22	12	2
berlandieri	Brownsville, Tex	83	19	12	6
tropicalis	Pluma and Juquila, Oaxaca, Mexico	93	25	12	6
soricina	Tlalpam, D. F. Valley of Mexico	91	26.5	12.5	3
obscura	Tulancingo, Hidalgo, Mexico	92.5	25	13	2
mexicana	Jico, Vera Cruz, Mexico	99	27	13.5	22
goldmani	Mountains near Chilpancingo, Guerrero, Mexico.	100	28.5	13.2	5
peregrina	Mountains near Oaxaca, Mexico	101.5	30	14	20
machetes	Mountains near Ozolotepec, Oaxaca, Mexico.	108	30.5	14.9	7
nelsoni	Volcano of Tuxtla, Vera Cruz, Mexico	106	29	13.3	11
alticola	Mount Popocatepetl, Mexico, Mexico	104	26	15	5
fossor	Mount Zempoaltepec, Oaxaca, Mexico	108	29	14.6	5
magna	Totontepec, Oaxaca, Mexico	134	42	17	1 (type)

Cranial measurements of typical specimens of Blarina.

Name.	Locality.	Greatest length (including front incisor).	Greatest breadth.
Blarina brevicauda	Blair, Nebr. (type locality)	25.4	[illegible]
telmalestes	Dismal Swamp, Virginia (type)	23	[illegible]
carolinensis	Columbia, S. C. (near type locality)	19	[illegible]
peninsulæ	Miami River, Florida (type)	20.3	[illegible]
parva	Blair, Nebr. (type locality)	16.5	7.3
floridana	Canaveral, Fla. (type)	18.2	[illegible]
berlandieri	Brownsville, Tex. (near type locality)	16.8	7.8
soricina	Tlalpam, Valley of Mexico (type)	18	[illegible]
tropicalis	Pluma, Oaxaca, Mexico	18.2	[illegible]
obscura	Tulancingo, Hidalgo, Mexico (type)	18	[illegible]
mexicana	Jico, Vera Cruz, Mexico (near type locality)	20	[illegible]
goldmani	Mountains near Chilpancingo, Guerrero, Mexico (type)	20	[illegible]
peregrina	Mountains near Oaxaca, Oaxaca, Mexico (type)	20.2	[illegible]
machetes	Mountains near Ozolotepec, Oaxaca, Mexico (type)	22	[illegible]
nelsoni	Volcano of Tuxtla, Vera Cruz, Mexico (type)	20.5	[illegible]
alticola	Mount Popocatepetl, Mexico, Mexico (type)	21	[illegible]
fossor	Mount Zempoaltepec, Oaxaca, Mexico (type)	21.2	[illegible]
magna	Totontepec, Oaxaca, Mexico (type)	24.5	[illegible]

NOTE.—The following two species of the subgenus *Cryptotis* were described by Dr. Allen after the present paper was in paged proof. Dr. Allen has kindly sent me the type specimens, and I am glad to be able to add the following descriptions:

BLARINA OROPHILA Allen.

Blarina (Soriciscus) orophila Allen, Bull. Am. Mus. Nat. Hist., New York, VII, p. 340, November 8, 1895.

Type locality.—Volcano of Irazu, Costa Rica.

"Pelage glossy, very short, soft and velvety. Above dark brown (shading slightly on seal brown), becoming lighter on the sides, and passing gradually into smoke gray on the ventral surface, where the hairs are conspicuously tipped with whitish. Feet grayish brown; tail dusky above, distinctly lighter below, well clothed, and with a minute pencil at tip. Ears rudimentary and not easily detected.

"*Measurements.*—Head and body, 55 mm.; tail vertebræ, 21 mm.; hind foot, 11 mm.; head, 20 mm.

"*Skull* (too imperfect for complete measurements).—Length of nasals, 5 mm.; length of upper tooth row, 8 mm.; distance between outer borders of last molars, 5.5 mm."

General remarks.—*Blarina orophila* is closely related to *B. tropicalis*, from which it differs in the shape of the bases of the first and second unicuspids when viewed from the outer side; they are narrow and have a pinched appearance instead of being broadly rounded off. The anterior cusp of the large upper premolar, to which Dr. Allen calls attention, is not longer than in *tropicalis* and falls far short of the middle cusp of the same tooth.

BLARINA NIGRESCENS Allen.

Blarina (Soriciscus) nigrescens Allen, Bull. Am. Mus. Nat. Hist., New York, VII, p. 339, November 8, 1895.

Type locality.—San Isidro (San Jose), Costa Rica.

"Pelage coarse, rather long, and not lustrous. Above dusky plumbeous, in some lights black; lower surface not appreciably different. Feet and tail blackish, nearly naked, the annulations of the latter being distinctly visible.

"*Measurements.*—Head and body, 65 mm.; tail vertebræ, 22 mm.; hind foot, 12 mm.

"*Skull.*—Total length, 20 mm.; mastoid breadth, 9.5 mm.; length of nasals, 7 mm.; length of upper tooth row, 9 mm.; distance between outer edges of last molars, 6.3 mm."

General remarks.—*Blarina nigrescens* is closely related to *B. nelsoni*, from which it may be distinguished by the even larger size of the large upper premolar. This tooth is exceedingly broad transversely and is strongly convex on its inner side. Its anterior cusp is nearly obsolete, while in *nelsoni* it is well developed. As in *nelsoni*, all the molariform teeth are very large and very slightly excavated posteriorly. The unicuspidate teeth have the inner cusplet fairly developed; in *nelsoni* it is nearly obsolete. The skull is slightly smaller, and the brain case narrower behind than in *nelsoni*.

Genus NOTIOSOREX Baird, 1877.

Notiosorex (subgenus of *Sorex*) Baird in Coues, Bull. U. S. Geol. and Geog. Surv., III, 1877, 646–647.

Notiosorex (full genus) Dobson, Mon. Insectivora, Part III, 1890, Pl. XXIII, fig. 20. Flower and Lydekker, Introduction to Study of Mammals, 1891, 624. Merriam, Proc. Biol. Soc. Washington, VII, 1892, 26.

Dental formula.—i, $\frac{3}{2}$; c, $\frac{1}{0}$; pm, $\frac{1}{1}$; m, $\frac{3}{3} = \frac{8}{6} \times 2 = \frac{16}{12} = 28$.

Teeth, 28; unicuspids, 3, forming a uniform series, the third more than half as large as second, never minute. Unicuspids narrow at base, without trace of secondary cusplet on inner side. Anterior teeth lightly tipped with orange; molars pure white. Cranium flat and broadly rounded. External ear conspicuous; tail short, less than half the length of head and body; body slender.


FIG. 2.—Skull of *Notiosorex*.

Geographic distribution.—Lower Sonoran fauna of the United States and Mexico, from southern Texas to southern California and southward in Mexico to Mazatlan, Sinaloa and the peninsula of Lower California.

HISTORY AND NOMENCLATUR

The genus *Notiosorex* is exceptionally free fr nomenclature and synonymy. It was described a 1861, but was not published until 1877, when C along with other of Baird's manuscript descriptic Notes on American Insectivorous Mammals.[1] Th was described by Baird under the name *Sorex* (. and came from Fort Bliss, N. Mex. (practically E same publication Coues described a specimen from a new species and named it *Sorex* (*Notiosorex*) *evo* have been described, and there are no synonyms prove a synonym of *crawfordi.*

Notiosorex was proposed as a subgenus of *Sore* generic rank by Dobson and by Flower and Lyd related to the Eurasian genus *Crocidura*, but the and flatter posteriorly. It is doubtful if the diffe it from *Crocidura* are of more than subgeneric we

NOTIOSOREX CRAWFORDI Bai

Sorex (*Notiosorex*) *crawfordi* Baird, Bull. U. S. Geol. and G 652. (From Fort Bliss, N. Mex.). Thomas, Proc. Zool (From San Diego, Duval County, Tex.).

Type from near Fort Bliss, New Mexico (practically El Pa S. Nat. Mus.)

Geographic distribution.—Parts of Lower Sono Texas to southern California, and thence southwa of the peninsula of Lower California.

General characters.—Size small, about equaling large for a Shrew, protruding conspicuously beyo and tail short, the latter about half the length of head; color plumbeous.

Color.—Upper parts plumbeous (near the 'oliv under parts whitish; tail bicolor, each side conco

Cranial and dental characters.—The cranial a have been described in the generic diagnosis. unicuspids are large and subequal; the third al ably more than half the second. Judging from I teeth of *evotis* (which he calls *crawfordi:* Mon. I 1890, Pl. XXIII, expl.) those of *crawfordi* are less upper premolar and molars are rather deeply e especially the latter.

Measurements of type specimen (alcoholic, as rec verted into millimeters).—Head and body, 48 m mm.; hind foot, 10 mm. An alcoholic specimen i lection (No. 31532) from San Diego, Tex., mea

[1] Bull. U. S. Geol. and Geog. Surv., III, No. 3,

n.; tail vertebræ, 26 mm.; hind foot, 10.5 mm.; ear, 6.5 mm. Mean alcoholics from San Diego, Tex. (as measured by Thomas): Head body, 56 mm.; tail vertebræ, 28 mm.; hind foot, 10 mm. Skull of specimen: Total length (including front incisors), 17.3 mm.; great- readth, 8 mm.

neral remarks.—*Notiosorex crawfordi* is either a very rare animal or local and difficult to capture, as only a few specimens have found way into museums, and most of these were collected in Duval ıty, Texas, by Mr. William Taylor. The Department of Agriculture ction contains one from San Diego, Texas, collected by William d; one from San Antonio, Texas, collected in 1890 by Mr. H. P. Att- r, and there is one in the Merriam collection from San Bernardino, ornia, collected April 19, 1886, by Mr. F. Stephens. The latter ie only one known from California and has not previously been ·ded.

hile this paper is passing through the press two specimens have received from Santa Anita in the southern part of Lower California. were collected by J. Ellis McLellan, May 13 and 18, 1895.

ie type specimen of *crawfordi* was described as an alcoholic in bad condition. It is now little more than a skeleton, but the skull good condition, except that the occiput has been injured. The of the type as described by Baird from the alcoholic specimen was ht chestnut brown above." This is the color of the alcoholic San o specimens. But no dependence can be placed on the color of iolic Shrews, since most of them change to chestnut or reddish n. The skin from San Antonio lacks the chestnut and is nearly ırm plumbeous, slightly browner above. The specimen from San ardino, Calif., which was at first assumed to be an undescribed es, agrees so closely with the San Antonio specimen that I am lling to separate it even subspecifically. It is plumbeous above, below, with the hairs of the back faintly washed with brownish. the only two specimens of *Notiosorex* from the United States that not been in alcohol are plumbeous, washed with brownish instead iestnut, while all the alcoholics that have been examined (about a dozen) have the upper parts strongly washed with chestnut.

ulls of *Notiosorex crawfordi* from San Antonio and San Diego, s, are identical with that of the type. The skull from San Ber- ino, Calif., differs from the type in the following points: Size slightly ler; muzzle more abruptly narrowed anteriorly; angle of tooth (seen in profile) greater at junction of molariform teeth with ıspidate series; large upper premolar larger (outer side longer and ıverse diameter greater). But these differences are not sufficient ırrant separation.

NOTIOSOREX CRAWFORDI EVOTIS (Coues).

Sorex (Notiosorex) evotis Coues, Bull. U. S. Geol. and Geog. Surv.
(From Mazatlan, Mexico.)
Notiosorex crawfordi Dobson (*not* Baird), Mon. Insectivora, Part III,
fig. 20. (From Mazatlan, Mexico.)
Type from Mazatlan, Sinaloa, Mexico. (No. 9066, U. S. Nat. Mus.)

Geographic distribution.—Neighborhood of Mazatlan; ra

General characters.—Similar to *N. crawfordi*, but slight darker.

Color.—Upper parts plumbeous, the tips of the hairs a ish; under parts hitish.

Cranial and racters.—The skull of *evotis* I the skull of the ing been lost or mislaid in the National Museu Dobson has figured the teeth from the type l Mon. Insectivora, Part III, fas XXIII, fig. 20), f correct, indicates that the t crowded than in *i*, and the second or middle unic being intermedia ght between the first and third. the first and sec ssentially subequal.

Measurements of type specimen (from dry skin, as recor converted into millimeters).—Head and body, 73 mm.; 23 mm. [probably 25 mm.]; hind foot, 11.5 mm.

General remarks.—In the absence of sufficient material is impossible to determine its exact relations to *crawf* did not recognize it as distinct, but figured its teeth u *crawfordi*. For the present it seems best to retain it as

LONG-TAILED SHREWS OF THE EASTERN UNITED STATES.

By Gerrit S. Miller, Jr.

ng the summer of 1894 I was enabled, through the kindness of ldfield Thomas, to examine in the British Museum the original ens of three Shrews (*Sorex palustris*, *S. forsteri*, and *S. parvus*) ed by Richardson nearly seventy years ago, but since then not ely identified. In explaining the results of this study it is ary to consider all the Long-tailed Shrews of the eastern United

ers on the Shrews of eastern North America have without ion worked with inadequate material, and, as a result, left the clature in a chaotic state. Thus, to the common *Sorex personatus* than ten specific names have been applied, while another species *forsteri* Baird *nec* Richardson) has been allowed to go unnamed. other hand, certain names—as, for instance, *Sorex forsteri* or *ichardsoni*—have been used to designate as many as three spe- Much of this confusion is the result of a lack of appreciation of ts that in determining closely allied Shrews it is necessary to e specimens in the same phase of pelage, and in which the l form of the teeth has not been sensibly altered by wear. The to which the form of the teeth changes with age is shown in Pl. . 8, as compared with figs. 5, 6, and 7. That there is much indi- variation in the form and relative size of the teeth is another stance which has not been properly taken into account. As a specimens of one Shrew have been referred to two or more spe- ced in different sections of the genus. Variation of this kind trated by figs. 5, 6, and 7 of Pl. IV, which show the unworn id teeth of three specimens of *Sorex personatus* taken at one . The seasonal changes in color are much greater than has pposed. *Sorex albibarbis* is in summer nearly unicolor, while er the belly is so much paler than the back and sides as to give mal a resemblance to the bicolored *S. palustris*. Many speci- f *Sorex fumeus* taken during mid-summer are by color alone fficulty separated from *S. personatus*, to which in winter it bears ness. In most Shrews the fur is noticeably longer and softer in and winter than in summer, and at the same time the colors ler and more strongly contrasted.

eparing the following revision of the species of *Sorex* occurring United States east of the Great Plains I have examined about rews from that region. This material is in part from my own

collection and the private collections of Dr. C. H
ram Bangs, and Mr. S. N. Rhoads. I have also
addition to the specimens in the British Museu
the Shrews belonging to the American Museum
United States Department of Agriculture, and c
mined by Baird in the United States National M

The three most important studies of the Sh
America are those of Bachman, 1837;[1] Baird, 18

The following table shows the names used b
seven species admitted in the present paper.

	Bachman, 1837.	Baird, 1857.
Sorex hoyi		S. hoyi
		S. thompsoni
palustris		
albibarbis		
richardsoni	S. richardsoni	S. pachyurus
fumeus		S. forsteri
		S. richardsoni
longirostris	S. longirostris	S. personatus ?
personatus	S. forsteri	S. cooperi
	S. fimbripes	S. platyrhinus
	S. cooperi	S. haydeni

The subject is so complicated that it is necessa
the history of each species.

Sorex hoyi.—*Sorex hoyi* was first described in 1
then has been almost unknown. At present t
dozen specimens in collections. *Sorex thompsoni*
described in the same paper with *S. hoyi*, is prob
from the latter.

In 1877 Dr. Coues published in his Precurso
Insectivorous Mammals[4] a diagnosis by Baird o
sorex based on *Sorex hoyi.* In this paper, as
description of the species, Baird overlooked th
and stated that *Sorex hoyi* had only 30 teeth.
detected until 1890, when Dobson figured the te

Sorex palustris.—The first notice of an Ameri
published in 1828, when Richardson describe
animal which he had found frequenting the b
region between Hudson Bay and the Rocky Mo

[1] Jour. Acad. Nat. Sci. Phila., VII, Part II.
[2] Mamm. N. Am.
[3] Mon. Insectivora, Part III, fasc. 1.
[4] Bull. U. S. Geol. and Geog. Surv., III,
[5] Zool. Jour., III, p. 517.

In 1857 Baird placed *Sorex palustris* among the species unknown to im, but which he considered as probably worthy of recognition. At he same time he described the new genus *Neosorex* and the species *Neosorex navigator*, from Washington.

Our first accurate knowledge of *Sorex palustris* dates from 1890, when Dr. Dobson figured the teeth of the type specimen,[1] and in another paper published the same year[2] discussed the validity of the genus *Neosorex*. Dr. Dobson came to the conclusion that *Sorex palustris* and *Neosorex navigator* are the same, and that *Neosorex*, so far from being a genus, can not even be recognized as a subgenus. A year later Dr. Merriam recorded *Sorex palustris* from Idaho, at the same time emarking that he considered *Neosorex* a very good subgenus.[3]

The type specimen of *Sorex palustris* in the British Museum is dingy nd discolored. For years it was exhibited as a mounted specimen, ut is now kept as a skin. In color it is unlike any Shrew that I have een, but resembles *S. bendirii* more than any other. The fur is gone om the middle of the belly, but what remains on the chin, throat, and ides agrees in color with that of the corresponding parts in *S. bendirii*. he color is, however, so obviously unnatural that it can not be condered of any importance, especially as it is not in the least as described y Richardson. Reasons have already been given for believing that ichardson's name should be applied to the paler-bellied western form f Marsh Shrew (Proc. Bost. Soc. Nat. Hist., XXVI, March 24, 1894, 81, 182), and after examining the type I see no necessity for changing his opinion. The specimen being in such condition as to furnish no vidence, it is still necessary to judge the old descriptions on their own erits. As all the early accounts of *Sorex palustris* refer to its pale, sh-gray belly, and as the geographical range—indefinite though it is—oincides with that of the western animal, it is proper to apply the ame to the latter. That the type of *Sorex palustris* is a *Neosorex* and ot an *Atophyrax* is shown by the teeth, which are nearly unworn.[4]

Sorex albibarbis.—The type of *Sorex albibarbis* was taken by Prof. E. D. Cope in 1859 at Profile Lake, New Hampshire. The original escription of the species appeared three years later in the Proceedings f the Philadelphia Academy of Sciences.[5]

Soon after Professor Cope published his account of *Sorex albibarbis* Prof. A. E. Verrill recorded a specimen from Warwick, Mass., and ttempted to prove the identity of the animal with Richardson's *Sorex palustris*.[6] In this attempt he was so far successful that he has been ollowed by Mr. J. A. Allen in his Catalogue of the Mammals of Mass.[7]

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[1] Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 18.

[2] Proc. Zool. Soc. London, p. 51.

[3] N. Am. Fauna No. 5, p. 35, July, 1891.

[4] The teeth as figured by Dobson (Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, g. 18) appear somewhat too deep from apex to root.

[5] Proc. Acad. Nat. Sci. Phila., 1862, p. 188.

[6] Proc. Bost. Soc. Nat. Hist., IX, p. 164, 1862.

[7] Bull. Mus. Comp. Zool., I, p. 211, 1869.

In 1892, however, Dr. Merriam enumerated both *Sorex albi* *S. palustris* among the mammals of the boreal zone,[1] while later the species was again recorded from Profile Lake, New H and also from Essex County, N. Y.[2] Still more recently M has taken *S. albibarbis* in Pennsylvania.[3]

Sorex richardsoni.—The American representative of *Sor* was discovered by Forster, who in 1772 recorded the species son Bay. Although Forster called the animal *Sorex araneus* that it had a blacker back and brighter colored sides than th European Shrew.

The species was next described by Richardson in the Faun Americana (1829). Here it was referred with some hesitatio *parvus* Say, a Shrew which is not even congeneric with *S. r* The specimen on which Richardson based his description *parvus* is in the British Museum, and though faded and di fectly identifiable. The color pattern can still be distinctly in size it agrees exactly with a specimen from Elk River, I

In 1837 Bachman, who already felt convinced that the Shr *Sorex parvus* by Richardson and Say were not the same, receiv men from Mr. William Cooper, on the strength of which Richardson's animal *Sorex richardsoni*. Cooper's specimen the Northwest Territory, which in the early thirties embrace ent States of Wisconsin, Iowa, Minnesota, northern Illinoi northern peninsula of Michigan. As the *Sorex parvus* of I is known to occur in this region, and as nothing in Bachman tion points to any other animal, the propriety of applying name *richardsoni* is hardly open to question, though there is bility that the Cooper specimen was really *S. fumeus*.

The animal was not noticed again until the year 1857, w described a specimen in full winter coat as a new species name *Sorex pachyurus*. The *Sorex richardsoni* of Baird is a summer specimen of *S. fumeus*.

The most recent mention of *Sorex richardsoni* is by Do figures the teeth for the first time. Dobson, like Forster, re animal to *Sorex vulgaris* [= *S. araneus*], the species to whic tainly most nearly allied.

Sorex fumeus.—The large slaty-plumbeous Shrew character Canadian fauna was first described by Baird in 1857. Bai specimens, one from Carlisle, Pa., and the other from Ra These he identified respectively as *Sorex forsteri* [= *S. perso* *Sorex richardsoni*, species widely different from each other *Sorex fumeus*. Both specimens are now in the National Mus type of Baird's *forsteri* is in the dark autumnal or winter p

[1] Proc. Biol. Soc. Washington, VII, p. 25, 1892.
[2] Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183, 1894.
[3] Proc. Acad. Nat. Sci., Phila. 1894, 395, Jan., 1895.

ence recognizable at a glance from the external characters alone. he original of his *richardsoni*, on the other hand, is a much worn sumer specimen, the determination of which might be a matter of uncerainty were it not for the excellent condition of the teeth and anterior art of the skull, which show it to be unquestionably *Sorex fumeus*.

From 1857 to 1890 *Sorex fumeus* escaped notice. The references to *orex forsteri* and *S. richardsoni* during this period are based on aird's statements concerning the species rather than on identification f specimens. In 1890, however, Dobson figured the teeth of an indiidual from Lake George, New York. This specimen he identified with e Kay's *Otisorex platyrhinus*, a totally different animal.

That this species should have remained until now unnamed is a atter of surprise. Nevertheless, a careful examination of the literare shows that none of the many names proposed for North American hrews can be applied to it. Of these names it is necessary to consider the present connection *Otisorex platyrhinus* De Kay and *Sorex platyhinchus* Linsley only. The former was based on a specimen from appan, Rockland County, N. Y. The essential part of the original escription is as follows:

Characteristics: Dark brown, paler beneath. Total length, 4 inches.

Description: * * * Ears very large, rounded and membranaceous, subangular the upper margin, sparsely covered within and without with long hairs; * * * nd feet slender, 0.8 inch long, sparsely covered with light rufous hairs; * * * fur er whole body quite long and thick, ranging from 0.2 to 0.4 inch; * * * teeth inute, tinged with piceous at their tips. Dental formula: Incisors, $\frac{2}{2}$; cheek teeth, =32. * * * Color: Dark cinereous, slightly tinged with dusky rufous, particurly on the upper part of the muzzle and inferior portion of the neck; beneath, h gray.

Length of head and body, 2.5 inches; length of tail, 1.6 inches; length of head, 9 inch; length of ear, 0.2 inch.

Nothing in this description refers unquestionably to the Shrew under nsideration. It is true that the statements concerning the color might fer to this animal. Since, however, they apply with equal pertinence the majority of known species of *Sorex*, they can not be considered of y diagnostic value. The stress that De Kay lays on the large ears of s specimen has led to the belief that he had in hand the larger of the o common species of *Sorex*, an animal with actually though not prortionally larger ears than *S. personatus*. The measurement—length of r, 2 lines (4 mm.)—was made no one knows how. As it stands it is out 2 mm. shorter than the ear of *S. fumeus* measured (in the dry skin) om the meatus, while it exceeds by a full millimeter, or 33 percent, the ight of ear above crown in dried specimens of the same animal.

On the other hand, *Otisorex platyrhinus* agrees in size with *Sorex pernatus*. "Total length, 4 inches" (100 mm.), and "length of tail, 1.6 ches" (38 mm.), are statements which apply to the latter species and t to *S. fumeus*.[1] The measurement of the hind foot, "8 lines"

[1] Ten specimens of *S. personatus* average: Length, 101 mm.; tail, 38.8 mm.: while like number of *S. fumeus* average: Length, 119 mm.; tail, 44.9 mm.

(19 mm.), is evidently an error, since it is about right for a size of *Sorex albibarbis*, and can apply to no true *Sorex* know eastern United States.

Although De Kay's account of ***Otisorex platyrhinus*** is so make the identification of his animal a matter of uncer description published by Linsley[1] of a specimen seen and De Kay is enough[2] to fix the name on the animal already *personatus* by Isidore Geoffroy Saint Hilaire.

Sorex longirostris.—In 1837 Bachman described a Shre swamps of the Santee River, South Carolina.[3] This anima *Sorex longirostris*. Although there is nothing in Bachma count by which the animal can be positively identified, th be applied to a very distinct species of Shrew occurring in t States. Efforts to secure topotypes of ***Sorex longirostris*** h failed, and the nearest point to the type locality from whic are known is Bertie County, N. C. It is very unlikely, ho a different Shrew occurs in the Santee region.

This Shrew is now recognized for the first time since B scribed it, unless the *Sorex personatus* of Baird was the type of Baird's *personatus* is a skin without skull of an ap mature Shrew taken near Washington, D. C. The specim condition as to be wholly unidentifiable, and nothing is k the Long-tailed Shrews that occur in the vicinity.

Sorex personatus.—Isidore Geoffroy Saint Hilaire descrit a Shrew which he called ***Sorex personatus***. No type local but the original specimen was collected by Milbert in the Un possibly in New York.[5] The description is sufficiently accu that the animal was the smaller common Long-tailed Sl eastern United States.

A few months later Richardson redescribed the species a *steri*.[6] The type in the British Musuem has been mou now kept as a skin. The fur has a peculiar brownish-fulv

[1] Sill. Am. Jour. Sci., XLIII, 346.

[2] This beautiful little quadruped was taken in a decayed apple-tre

sult probably of long exposure. The teeth are so worn that the cisors are reduced to mere stubs. In spite of all this, there can be no ubt that the specimen is a typical *Sorex personatus*. The hind foot easures 11 mm.

The next reference to *Sorex personatus* was made by Gapper, who scribed and figured the animal under the name *Sorex forsteri* in e Zoological Journal for 1830. Gapper's specimens came from the gion between York and Lake Simcoe, Ontario.

The *Sorex cooperi* which Bachman named in 1837 is without doubt e present species.

Bachman's *Sorex fimbripes*, described in the same paper with *S. rich-dsoni* and *S. cooperi*, is said by Dr. Coues,[1] who has examined the pposed type, to be a perfectly normal *Sorex personatus*. How Bach-an could see in such a specimen the remarkable characters ascribed *S. fimbripes* is beyond comprehension. On Bachman's account of *fimbripes* is based the generic name *Hydrogale* Pomel.[2] The type *Sorex fimbripes* was collected in Lycoming County, Pa., on Drurys un, a branch of the Schuylkill River.

The *Amphisorex lesueuri* of Duvernoy[3] from Indiana, is apparently abnormal example of *Sorex personatus*. It is said to have a whitish reak running from the eye to the corner of the mouth.

Sorex platyrhinchus Linsley and *Otisorex platyrhinus* De Kay have en discussed in detail under *Sorex fumeus*. There can be no question at both names are synonyms of *Sorex personatus*.

In 1857 Baird recognized five small Shrews from the eastern United tates. Two of these—*Sorex platyrhinus* and *S. cooperi*—were based individual variations of the present species. Specimens with the nicuspid teeth, as shown in Pl. IV, fig. 5, were referred to *S. cooperi*, hile those with the teeth, as in Pl. IV, figs. 6 or 7, were called *S. platy-hinus*. At the same time Baird described as a new species *Sorex hay-eni*,[4] from Fort Buford, N. Dak. Certain slight peculiarities in a few ecimens from this general region indicate that *Sorex haydeni* may entually be recognized as a local race of *S. personatus*. For the esent, however, the forms are best united under the latter name.

From 1857 to 1890 *Sorex personatus* has been referred to as *S. cooperi*, *platyrhinus*, or *S. personatus* indifferently. In 1890, however, Dr. bson added to the list of synonyms by figuring the teeth of an indi-ual from Halifax, Nova Scotia, under the name *Sorex richardsoni*.[5] The next year Dr. Merriam described specimens from Idaho as a new ecies, *Sorex idahoensis*.[6]

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[1] Bull. U. S. Geol. and Geog. Surv., III, No. 3.

[2] Archiv. Sci. Phys. and Nat., Genève, IX, 248, Nov., 1848.

[3] Magasin de Zoologie, Mamm., p. 33, Pl. L, 1842.

[4] Mamm. N. Am., p. 29.

[5] Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 9.

[6] North American Fauna, No. 5, p. 32.

In 1894 Mr. J. A. Allen recorded a large series of *Sore*
from New Brunswick as *Sorex forsteri*,[1] the name first a
animal by Richardson more than sixty years before.

KEY TO THE SPECIES OF SOREX OCCURRING IN THE UNI EAST OF THE GREAT PLAINS.

A distinct secondary cusp on the inner side of the canine and second
third upper incisors (subgenus *Microsorex*)..........................
No secondary cusp on the canine or any of the incisors except the fir
Feet conspicuously fringed; size large (total length usually more
150 mm.; hind foot, over 18 mm). (Subgenus *Neosorex*.)
Distinctly bicolor; belly nearly white, in strong contrast
color of back; chin not paler than rest of ventral surface.
Nearly unicolor, or with belly somewhat grayer than back;
paler than rest of ventral surface..........................
Feet not fringed; size medium or small (total length, less than 140
hind foot never more than 16 mm). (Subgenus *Sorex*.)
Average length, over 110 mm.; tail more than 40 mm.
A well-defined dark dorsal area ....
Back not noticeably darker than sides..........................
Average length, under 105 mm.; tail less than 40 mm.
Canine normally smaller than fourth incisor, rostrum b
(ratio of greatest anteorbital breadth to palatal len
78) ....
Canine normally equal to or larger than fourth incisor, rost
narrow (ratio of greatest anteorbital breadth to pa
length, 61 : 71)..........................

Subgenus MICROSOREX Baird.

Microsorex Baird in Coues Precursory Notes on American Insectivo
Bull. U. S. Geol. and Geog. Surv., III, No. 3, 646, 1877. Type, *Sore*

Inner side of canine and second and third upper inciso
tinct secondary cusp (fig. 1*c*); fourth upper incisor very

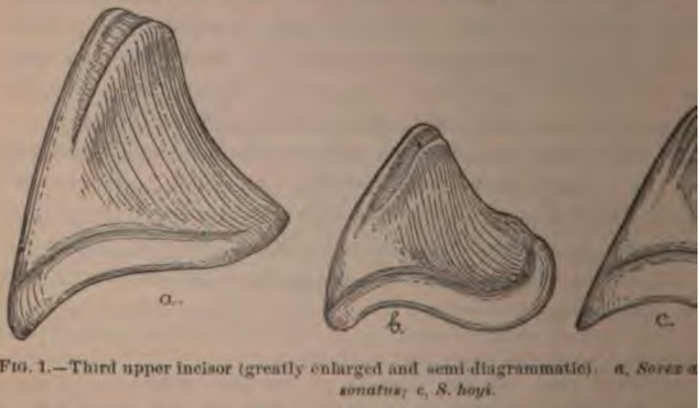

FIG. 1.—Third upper incisor (greatly enlarged and semi-diagrammatic). *a*, *Sorex a*
sonatus; *c*, *S. hoyi*.

nearly hidden between the third incisor and canine; br
and narrow (ratio of cranial breadth to total length of s
from 42 to 47); mandible short and heavy; feet never frin

[1] Bull. Am. Mus. Nat. Hist., VI, p. 100, Apr. 24.

;aird established the subgenus *Microsorex* in 1877 in a paper pub-
ied by Dr. Coues. The characters as originally given were false, ce it was supposed that *Sorex hoyi*, the type of the subgenus, had y 30 teeth, while in reality it has 32, the number normally present the genus. Although the subgenus can not be distinguished by number of teeth, it is amply characterized by cranial and dental uliarities which will be more fully discussed in the description of *rex hoyi*. The form of the skull, and especially of the mandible, in s Shrew is so peculiar as to suggest that it may be necessary even-lly to recognize *Microsorex* as a full genus.

io far as known, *Microsorex* is peculiar to America, where it is repre-ted by one species, *Sorex hoyi* Baird.

SOREX HOYI Baird.

(Pl. V, figs. 6 and 7; Pl. VI, figs. 10 and 10*a*.)

'. *Sorex hoyi* Baird, Mamm. N. Am., p. 32. (Racine, Wis.)
'. *Sorex thompsoni* Baird, Mamm. N. Am., p. 34. (Burlington, Vt.)
!. *Sorex thompsoni* Verrill, Proc. Bost. Soc. Nat. Hist., IX, p. 169. (Maine.)
). *Sorex hoyi* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, figs. 15, 16*a*. (New York and Manitoba.)

'ype locality.—Racine, Wisconsin.

leographic distribution.—Boreal zone and adjacent part of Transi-ı zone from Minnesota to New Brunswick and Nova Scotia.

leneral characters.—*Sorex hoyi* is the only known species of *Micro-ex*. It may be recognized by the subgeneric characters.

'olor.—Back and sides hair brown, more or less darkened with clove wn on the former, and shading, without line of demarcation, into pale hair brown or silver gray of the belly. Dorsum of manus and and ventral surface of tail pale Isabella color. Region between ıt legs usually tinged with fulvous.

'he color of the back varies slightly, being more darkened with ve brown in some individuals than in others. The chest is often y strongly tinged with fulvous, and at least a trace of this color is sent in every specimen that I have examined.

'kull.—The skull of *Sorex hoyi* (Pl. VI, figs. 10, 10*a*) is small, thin, and ery. In form it differs from that of other species of *Sorex* in the tened and narrowed brain case and in the short thick mandible, latter resembling that of the smaller species of *Blarina*. The pecu-ities in form as compared with *Sorex personatus* and *S. richardsoni* shown in the following table of approximate cranial ratios:

	Sorex hoyi.	Sorex personatus.	Sorex richardsoni.
of cranial breadth to total length of skull	45	51	51
of greatest anteorbital breadth to total length of skull	28	28	27
of rostral breadth to palatal length	80	70	65
of palatal breadth to cranial breadth	60	55	52
of palatal depth to cranial depth	40	51	40
of cranial depth to cranial width	49	54	53

Teeth.—The teeth of the upper molariform s
tinguished from the corresponding teeth in *So*
the slightly different form of the excavations o
These excavations in *S. personatus* are deepest
teeth, while in *S. hoyi* the deepest points are di
borders.

The unicuspid teeth of *Sorex hoyi* are (Pl. V
and heavily pigmented, the colored area occ
of the outer face of the second and third inci
on the canine. The second and third inciso
the second slightly the larger. The canine i
the third incisor. The premolar and the fourth
though both are visible from the outer side.
small that it is readily overlooked in alcoholi
that are not properly cleaned. In a specim
New Brunswick, both premolar and fourth inci
(Pl. V, fig. 6), but no other specimens from the
peculiarities to separate them from true *S. hoy*

The crowns of the second and third incisors,
canine in *Sorex hoyi* are remarkable for the
forming the inner edge of the pyramidal main
is present in all species of *Sorex*, is here gre
vided near its base with a distinct, pigmented,
This cusp is not homologous with the minut
of the unicuspid teeth of *Blarina*, as the latt
cingulum and is near the hinder edge of the to
cusp in *Microsorex* is distinct from the cing
in front of the middle of the tooth. Althoug
the secondary cusp in *Microsorex* is not equall
of true *Sorex*, it is never entirely absent. It
araneus (fig. 1*a*), *S. alpinus*, and *S. richardsoni*,
and sometimes even tending to form a rudime
S. personatus (fig. 1*b*), and others.

The mandibular teeth, like the mandible its
and strongly built. While the individual teet
than in *S. personatus*, the tooth row as a who
show no essential differences in form beyond t

Measurements.—Unfortunately, most of the
that I have seen were not measured in the fi
ble to give satisfactory measurements for the
specimen from Steele County, Minn., measur
vertebræ, 27 mm.; hind foot, 10 mm. Three a
Elk River, Minn., average: Length, 81.7 mm.;
hind foot, 10.7 mm.

General remarks.—*Sorex hoyi* differs so wide
Sorex in its subgeneric characters that it needs
Superficially it has much the appearance of a
tailed *S. personatus*.

Subgenus NEOSOREX Baird.

Neosorex Baird, Mamm. N. Am., p. 11, 1857. Type, *Neosorex navigator* Baird.

Inner side of canine and incisors without secondary cusps; fourth upper incisor well developed; brain case broad (ratio of cranial breadth to total length of skull ranging from 52 to 56); mandible slender and lightly built; feet conspicuously fringed with bristle-like hairs, as in *Crossopus*.

The subgenus *Neosorex* was first described in 1857 by Baird, who considered the single species known to him entitled to full generic rank. In this decision he was followed by authors until 1890, when Dr. Dobson (Proc. Zool. Soc. London, p. 51) came to the conclusion that *Neosorex* "can not even be considered as * * * a subgenus." Dr. Merriam has more recently (North American Fauna, No. 5, July, 1891, p. 35) expressed the opinion that *Neosorex* is "a very good subgenus," and this ruling appears to be the most satisfactory.

Neosorex is confined to America, and although not closely related to the Old World *Crossopus*, shows a remarkable parallelism with the latter both in habits and in external appearance. Both are aquatic, inhabiting marshes and the borders of streams, and the likeness between freshly killed specimens of the two Shrews is very remarkable. *Crossopus* is, however, the more robust animal with shorter tail and broader muzzle.

SOREX PALUSTRIS Richardson.

(Pl. V, fig. 1; Pl. VI, figs. 1 and 1*a*.)

1828. *Sorex palustris* Richardson, Zool. Jour., III, p. 517. (Hudson Bay to Rocky Mts.)
1853. *Sorex palustris* Aud. and Bach., Quadrupeds N. Am., III, p. 108, Pl. CXXV.
1890. *Sorex palustris* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 18 (teeth of type).
1891. *Sorex palustris* Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183. (Minnesota.)

Type locality.—Unknown; somewhere in the region between Hudson Bay and the Rocky Mountains. (Type in the British Museum.)

Geographic distribution.—Boreal zone from Hudson Bay and central Minnesota west to the Rocky Mountains.

General characters.—*Sorex palustris* is distinguished by its subgeneric characters from all other eastern American Shrews except *S. albibarbis*. From the latter it is separated by its shorter, broader, more heavily pigmented unicuspid teeth, and the sharply defined whitish color of the belly.

Color.—Dorsal surface very dark seal brown with a slight gloss, each hair with a narrow subterminal band of smoke gray separating the seal brown tip from the slate-gray under fur, and producing a grizzled appearance when the animal is viewed in certain lights; ventral surface very pale smoke gray, nearly white, and often faintly tinged with cream color; the color of the belly extending a short distance on the sides, where it shades quickly into the color of the back; inn of all four legs colored like the belly; dorsum of manus and paler on the inner half; tail clear seal brown dorsally and a smoke gray ventrally, this gray area broad proximally, but so ing to a mere line, which persists to the extreme tip.

In the worn summer coat the belly is variously discolored w ish and yellowish, the animal usually, however, remaining sl distinctly bicolor.

Skull.—The skull of *Sorex palustris* is large and heavily l the brain case broad and high. Otherwise it does not differ from the skull of *S. araneus* or *S. richardsoni*. The anteri of the infraorbital canal is large and elliptical in outlin defined on all sides except in front. The posterior border point slightly behind the middle of the first molar. Close t terior border of this opening is the small lachrymal foramen.

Teeth.—The teeth of *Sorex palustris* are large, strong, an pigmented (Pl. V, fig. 1). The molariform teeth do not diff from those of *S. araneus* and *S. richardsoni*, except that the borders of the upper molars are more extensively excavated, part of the excavation being nearer the inner borders of The unicuspid teeth, however, show more obvious differer second and third incisors are subequal, the latter slightly t The fourth incisor is less than half the size of the canine turn is distinctly smaller than the second incisor. The p minute but in the tooth row and distinctly pigmented at the

Measurements.—It happens that very few of the specimen *palustris* that I have seen were measured in the flesh. A South Edmonton, Alberta: Length, 157 mm.; tail vertebræ hind foot, 20 mm. Another male, from Tower, Minn.: Length tail vertebræ, 65 mm.; hind foot, 19 mm.

SOREX ALBIBARBIS (Cope).

1862. *Neosorex albibarbis* Cope, Proc. Acad. Nat. Sci. Phila., p. 188. (New l
1862. *Neosorex palustris* Verrill, Proc. Bost. Soc. Nat. Hist., IX, p. 164. (Ma
1892. *Sorex albibarbis* Merriam, Proc. Biol. Soc. Washington, VII, p. 25.
1894. *Sorex albibarbis* Miller, Proc. Bost. Soc. Nat. Hist., XXVI, p. 183. (shire and New York.)

Type locality.—Profile Lake, New Hampshire.

Geographic distribution.—Boreal zone in the eastern Unit and Canada from Pennsylvania north at least to Nova Scoti bec. Specimens examined from Nova Scotia, Quebec (Lac au

[1] I am somewhat in doubt as to the correct name for this foramen. Pa ently alludes to it in his description of the adult skull of *Sorex araneus* (Royal Soc., CLXXVI, 213, 1886) when he says "the canal wall for the nerve is itself perforated," though in reality the foramen in question d into the infraorbital canal, but on the contrary into a tube lying super latter and penetrating the skull in the direction of the nasal cavity.

New York (Essex County), New Hampshire (Profile Lake), Maine (Lincoln), and Pennsylvania (Monroe County).

General characters.—In size equal to *Sorex palustris.* Teeth narrower, longer, and less heavily pigmented than in the latter. Color of belly never sharply defined from that of the sides.

Color.—In summer: Dorsal surface very dark seal brown, almost black, with faint reflections, the hairs marked subterminally with smoke gray, thus producing a slight grizzled appearance; fur everywhere slate gray at base; ventral surface sepia, a little mixed with smoke gray, becoming clear, pale smoke gray on chin and fading insensibly into color of back; dorsum of manus and pes sepia, paler on inner side, the former also paler distally; tail clove brown dorsally, grayish ventrally. In winter: Back as in the summer pelage; belly pale hair brown or silvery smoke gray, according to light; a distinctly darker shade between the front legs and a paler area on chin. On the sides the color of belly shades gradually into that of back; otherwise as in the worn summer pelage.

Skull.—The skull of *Sorex albibarbis* (Pl. VI, fig. 2) resembles that of *S. palustris* so closely that the description of the former will suffice for both.

Teeth.—The teeth of *Sorex albibarbis* differ somewhat from those of *S. palustris* in the form and pigmentation of the unicuspids (Pl. V, fig. 2). These are slightly narrower and longer from point to base, and are less extensively pigmented at the tips than in *S. palustris.*

Measurements.—Seven adults from Elizabethtown, N. Y. Average: Length, 154.7 mm.; tail vertebræ, 71.3 mm.; hind foot, 19.3 mm. Two specimens from Profile Lake, New Hampshire, measure, respectively: Length, 157 mm.; tail vertebræ, 68 mm.; hind foot, 19 mm.; and, length, 149 mm.; tail vertebræ, 65 mm.; hind foot, 19 mm.

General remarks.—*Sorex albibarbis* needs comparison with *S. palustris* only. In color summer specimens of *S. albibarbis* are very different from *S. palustris* and remarkably like *S.* (*Atophyrax*) *bendirii*, a species readily distinguished by its cranial and dental characters. The winter coats of *Sorex albibarbis* and *S. palustris* sometimes resemble each other rather closely. In the former the color of the belly shades gradually into that of the back, while the chin is noticeably paler than the rest of the ventral surface. In the latter the color of the ventral surface is uniformly pale and separated from that of the back by a sharp line of demarcation. On the other hand, the two animals are, as already stated, very differently colored in summer, when *Sorex albibarbis* may be recognized at a glance by its brownish belly, *S. palustris* being then colored practically as in autumn and winter.

Subgenus SOREX Linn.

Sorex Linnæus, Syst. Nat., ed. X, p. 53, 1758. Type, *Sorex araneus* Linn.

Inner side of canine and incisor without secondary cusps (figs. 1*a*, 1*b*); fourth upper incisor well developed; brain case moderately broad (ratio of cranial breadth to total length of skull, about 50); mandible slender and lightly built; feet never fringed.

The Shrews of the subgenus *Sorex* occurring in eastern North America fall naturally into three groups. Two of these are found in Europe also; the third appears to be peculiar to America. The first, or *araneus* group, represented in Europe by the type of the genus, *Sorex araneus*, and the closely related *S. alpinus*, is replaced in eastern North America by *S. richardsoni* and *S. fumeus;* the second, or *minutus* group, to which belongs the American *S. personatus*, has for its European member *S. minutus;* the third, or *longirostris* group, contains the one species, *Sorex longirostris* Bachman. The species of the *araneus* group are characterized by their large size, strongly built skulls, and the slight development of the ridge on the antero-internal edges of the cusps of the unicuspidate teeth (fig. 1*a*). The Shrews of the *minutus* group are all small, with light papery skulls, and the antero-internal ridge on the cusps of the unicuspidate teeth well developed and occasionally showing the first suggestion of the minute secondary cusp characteristic of the subgenus *Microsorex* (fig. 1*b*). *Sorex longirostris*, also a very small animal, is distinguished from the members of the *minutus* group by its remarkably short, broad rostrum, and by the small size of the fourth incisor. This tooth in *S. longirostris* is smaller than the canine, while in the *minutus* group it is as large or larger.

SOREX RICHARDSONI Bachman.

(Pl. V, fig. 4; Pl. VI, figs. 4 and 4*a*.)

1772. *Sorex araneus* Forster, Philos. Trans., LXII, p. 381. (Hudson Bay.)
1829. *Sorex parvus* Richardson, Fauna Boreali-Americana, I, p. 8. Not *S. parvus* Say, 1823. (No locality.)
1837. *Sorex richardsoni* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 383, Pl. XXIV, fig. 5. (Northwest Territory.)
1857. *Sorex pachyurus* Baird, Mamm. N. Am., p. 20. Not *S. pachyurus* Küster, 1835. (Pembina, Minn.)
1890. *Sorex vulgaris* Dobson, Mon. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 4. (Manitoba.)

Type locality.—Unknown.

Geographic distribution.—Boreal zone from Minnesota and Manitoba west to Alberta. Limits of range not determined.

General characters.—Size large, equaling *S. araneus;* back with a dark median area evident at all seasons, but especially so in winter.

Color.—In winter: Fur everywhere slaty blackish at base; back with a broad, sharply defined area of very dark walnut brown extending from base of tail to occiput, beyond which it fades into color of

; this area broadest over lumbar region and shoulders, narrowest back of shoulders; sides yellowish hair brown in striking contrast, color clear and pure from flanks to sides of head but across the mixing with the walnut brown of the back; belly pale hair brown; indistinct line of demarcation between colors of belly and sides; tral surface of tail and dorsum of manus and pes concolor with s; tail seal brown dorsally and at tip, though not sharply bicolor. summer: Back dull seal brown, darker over rump and lumbar on; sides light sepia, darker on shoulders and flanks; belly uniform broccoli brown. Feet and tail as in winter. There is in summer h more color variation than in winter. A few individuals are then ark as in winter, but the majority are paler. The palest specimen I have seen is dark hair brown on the back, pale sepia on the sides, broccoli brown on the belly. The line of demarcation between the rs of the back and sides is always well marked, though the color of latter often fades insensibly into that of the belly.

kull.—The skull of *Sorex richardsoni* (Pl. VI, fig. 4) is indistinguish- from that of *Sorex araneus* (Pl. VI, fig. 3). The brain case is well ded and moderately high, less so than in *Sorex palustris* and *S. barbis*. The rostrum is slender (narrower than in *S. fumeus*), and compared with the species of the *minutus* group rather deep (see e, page 43). The anterior opening of the infraorbital canal is circular, the outline distinct on the lower and posterior borders, the terior border over a point a little in advance of the middle of the molar. The lachrymal foramen opens exactly over the middle of first molar.

eeth.—In general the teeth of *Sorex richardsoni* resemble those of *raneus* very closely, differing chiefly in their slightly larger size in a few details in the proportions of the unicuspids. The lat- (Pl. V, fig. 4), like the skull, are strongly and heavily built. The nd and third incisors are subequal, the second usually the larger. canine and the fourth incisor are subequal, the latter always the er of the two and either intermediate in size between the canine the third incisor or more nearly the size of the canine. The pre- ar is small, but distinctly visible from the outer side. The teeth are ngly colored at the points, the colored area on the front incisors of h jaws being continuous, and on the unicuspids occupying a little than one-third of the outer face of the unworn teeth.

Vhile the teeth of *Sorex richardsoni* resemble those of both *Sorex eus* and *Sorex araneus*, they are more like the latter. From the h of the former they differ in larger size, more extensive pigmen- on, and greater relative size of the canine and fourth incisor. From teeth of *S. araneus* those of *S. richardsoni* may be distinguished by proportionally smaller premolar and larger canine. From both *neus* and *fumeus*, *richardsoni* differs in the less extensive excava- of the posterior borders of the upper molariform teeth.

Measurements.—Ten specimens from South Edmonton, Alberta. Average: Length, 112.6 mm.; tail vertebræ, 40.1 mm.; hind foot, 13.8 mm. Maximum: Length, 118 mm.; tail vertebræ, 42 mm.; hind foot, 15 mm. Minimum: Length, 108 mm.; tail vertebræ, 38 mm.; hind foot, 13 mm.

General remarks.—While *Sorex richardsoni* is totally different in color from all other American Shrews, it closely resembles the European *Sorex araneus* Linn.[1] So close is this resemblance that the animals have been thought identical by at least two authors—Forster, in 1772, and Dobson, one hundred and twenty years later. As Forster remarks, however, the back is distinctly darker in the American animal. *Sorex richardsoni* in winter, at least, is very constant in color, but *Sorex araneus* varies so excessively at all seasons that it is not easy to make a proper comparison between the two species. In a series of about 30 of the latter collected near Lyndhurst, in the New Forest, southern England, during June, 1894, there is every shade of intergradation between specimens practically indistinguishable in color from the paler winter examples of *S. richardsoni*, and those with no distinct marking of any kind, the whole body being a dull, pale brownish drab, slightly darker on the back. Taking, however, the darker examples of *S. araneus* it is seen that the dorsal area is constantly less dark than in *S. richardsoni*, while the colored area on the sides is narrower, paler, and not so sharply defined from the color of the belly. Even in winter the fur on the back is in *S. araneus* scarcely more than half as long as in *S. richardsoni* at the same season.

The close agreement in size of *Sorex richardsoni* and *Sorex araneus* is shown by comparison of the measurements of the former with the following averages and extremes of 10 specimens of the latter animal from the New Forest, England: Average: Length, 117.9 mm.; tail vertebræ, 39.3 mm.; hind foot, 13.9 mm. Maximum: Length, 124 mm.; tail vertebræ, 42.6 mm.; hind foot, 14.8 mm. Minimum: Length, 113 mm.; tail vertebræ, 35 mm.; hind foot, 13 mm. The slight discrepancy in the total length of the two animals is more apparent than real, since it may easily be accounted for as the result of different methods of taking this measurement.

SOREX FUMEUS sp. nov.

(Pl. V, fig. 5; Pl. VI, figs. 5 and 5*a*.)

1857. *Sorex forsteri* Baird, Mamm. N. Am., p. 22. From Carlisle, Pa. (nec Richardson, 1819).

1857. *Sorex richardsoni* Baird, Mamm. N. Am., p. 24. From Racine, Wis. (nec Bachman, 1837).

1890. *Sorex platyrhinus* Dobson, Mon. Insectivora, Part III, fasc. 1; Pl. XXIII, fig. 5. From Lake George, New York (nec De Kay, 1842).

Type locality.—Peterboro, N. Y. Type, ♀ ad., No. 2582, collection of G. S. Miller, jr., taken September 24, 1893.

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[1] *Sorex araneus* Linn., Syst. Nat., ed. X, p. 53, 1758. See Thomas, The Zoologist, p. 63, 1895.

Geographic distribution.—Boreal zone and locally the cooler parts of the Transition zone in the eastern United States, Nova Scotia, and New Brunswick, west to Ontario and the Great Lakes.

General characters.—About the size of *Sorex richardsoni*. Back without distinct dark median area. Color smoky plumbeous gray.

Color.—In autumn and winter: Back smoke gray, the hairs everywhere tipped with seal brown, producing a finely grizzled appearance; the dark tips slightly more conspicuous over rump and lumbar region, less numerous on the sides, and disappearing entirely on the belly, where the fur is pale broccoli brown. Everywhere the fur, which is slate color at base, has a faint gloss. The result is a combination of colors very hard to describe, but unlike that of any other Shrew occurring in eastern North America. Tail indistinctly bicolor, seal brown dorsally, yellowish white ventrally; feet yellowish white. In summer: Dull hair brown throughout, paler on the belly, and very slightly darker on the back.

Specimens in the dull, short summer coat are much like the average *S. personatus* in color, but are usually paler, and may always be distinguished by a peculiar bluish cast. A specimen taken at Lake George, New York, July 10, 1892, has the full, dark autumnal pelage appearing on the rump and buttocks in strong contrast with the short pale fur on the rest of the body.

Skull.—The skull of *Sorex fumeus* (Pl. VI, fig. 5) is a trifle smaller than that of *S. araneus* or *S. richardsoni*. The brain case is narrower than in the other members of the *araneus* group, while the rostrum and interorbital region are broader. The anterior opening of the infraorbital canal is larger than in *S. richardsoni* and placed farther back, the posterior border of the foramen lying over a point decidedly behind the middle of the first molar instead of in front of the middle, as in *S. richardsoni* and *S. araneus*. The lachrymal foramen is over the space between the first and second molars.

Teeth.—The teeth of *Sorex fumeus* resemble in a general way those of *S. richardsoni* and *S. araneus*, but are smaller and less pigmented. The posterior borders of the upper molariform teeth are more extensively excavated than in *S. richardsoni*, thus resembling *S. araneus*.

The unicuspid teeth in profile (Pl. V, fig. 5) are shorter and broader than in the other members of the *araneus* group. The second and third incisors are subequal, the second usually slightly the larger; the fourth abruptly smaller than the third, and distinctly larger than the canine; the first premolar very small, but visible from the outer side. When slightly worn the unicuspid teeth show a peculiarity shared by the members of the *minutus* group, but not often occurring in the allies of *S. araneus*; the points of these teeth wear away more rapidly on the outer side, so that when seen in profile the less worn inner edge often appears as a prominence suggesting an incipient secondary cusp projecting backward below the tip of the main cusp. In *Sorex araneus* and *S. richardsoni* the inner side of the cusp wears away as fast, or nearly as fast, as the outer side, and this semblance to an accessory cusp seldom appears.

Measurements.—Type specimen: Length, 116 mm.; tail vertebræ, 44 mm.; hind foot, 12.6 mm. Six others from type locality average: Length, 116 mm.; tail vertebræ, 45.4 mm.; hind foot, 13.2 mm. Seven adults from Elizabethtown, Essex County, N. Y., average: Length, 119 mm.; tail vertebræ, 43.7 mm.; hind foot, 13.1 mm.

General remarks.—*Sorex fumeus* is very different from any of the other Shrews found in the eastern United States. In size it about equals *S. richardsoni*, but is readily distinguished from the latter by the absence of a well-marked dark dorsal area and by cranial and dental characters. The anterior orifice of the infraorbital canal lies farther back in *S. fumeus*, while the unicuspid teeth are narrower and less robust, as well as different in form.

Overstuffed skins of *Sorex personatus* are superficially much like *S. fumeus* in the dull summer coat, but there is never any difficulty in determining specimens that have been measured in the flesh or that are accompanied by skulls.

SOREX LONGIROSTRIS Bachman.

(Pl. IV, figs. 2, 3, and 4; Pl. VI, fig. 9.)

1837. *Sorex longirostris* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 370, Pl. XXIII, fig. 2. (Swamps of Santee River, South Carolina.)

1857. ?? *Sorex personatus* Baird, Mamm. N. Am., p. 30. (Washington, D. C.)

Type locality.—Swamps of the Santee River, South Carolina.

Geographic distribution.—*Sorex longirostris* is at present known to occur in Bertie County, N. C., and at Raleigh, N. C.

General characters.—In size and external appearance *Sorex longirostris* is very similar to *S. personatus*. It differs from all the Shrews of the eastern United States in its broad rostrum and small fourth upper incisor.

Color.—Dorsal surface uniform sepia, faintly tinged with chestnut on rump, fading to broccoli brown on the sides, and this in turn to smoke gray on the belly; no lines of demarcation anywhere; fur everywhere slate colored at base; dorsum of manus and pes pale Isabella color; tail obscurely bicolor, sepia dorsally and at tip, dirty white ventrally. The three specimens which I have before me, all taken at Raleigh, N. C., in January and February, show no variation in color, except that one has the belly distinctly washed with broccoli brown.

Skull.—The skull of *Sorex longirostris* (Pl. VI, fig. 9) is shorter than that of *S. personatus* and has the rostrum broader as compared with the brain case. The bony palate is remarkably broad and short, the rows of unicuspid teeth being especially widely separated as compared with *S. personatus*. The anterior opening of the infraorbital canal is moderately large and subcircular in outline. The posterior border is over a int slightly in front of the middle of the first molar. The lachrymal amen is of the same size and shape as in the other small Shrews, and placed a little behind the middle of the first molar.

Teeth.—Except for the different proportions of the unicuspids the th of *Sorex longirostris* closely resemble those of *S. personatus*. The cavations on the posterior borders of the upper molariform teeth, wever, are less extensive in *S. longirostris* and are widest near the ddle of each tooth, while in *S. personatus* the widest part is nearer e internal border. The difference is most strongly marked in the ge second premolar.

The unicuspid teeth (Pl. IV, figs. 2, 3, and 4) resemble those of no her *Sorex* found in the eastern United States. The second and third isors are large and subequal, the latter being slightly the larger, the rth very much smaller than the second or third, and also distinctly aller than the canine. The first premolar is minute and just visible m the outer side. All the teeth are tipped with chestnut brown to lightly greater extent than usual in *S. personatus*.

The teeth vary somewhat in relative size, as shown by the figures, fourth incisor occasionally nearly equaling the canine. In one ecimen the size and form of the fourth incisor differs appreciably in opposite sides of the jaw.

Measurements.—Four adults from Raleigh, N. C. Average: Length, 75 mm.; tail vertebræ, 33.25 mm.; hind foot, 10.75 mm.

General remarks.—*Sorex longirostris* resembles *S. personatus* in exterl appearance, but differs from this species very widely in the remarkly broad, short rostral part of the skull. This difference is especially ticeable when the palates of the two are compared.

SOREX PERSONATUS Isidore Geoffroy Saint Hilaire.

(Pl. IV, figs. 1, 5, 6, 7, and 8; Pl. VI, figs. 7 and 8.)

7. *Sorex personatus* I. Geoffroy Saint Hilaire, Mém. Mus. d'Hist. Nat., Paris, XV, p. 122. (United States.)
8. *Sorex forsteri* Richardson, Zool. Jour., III, p. 516. (Fur countries to lat. 67°.)
7. *Sorex cooperi* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 388, Pl. XXIV, fig. 7. (Northwest Territory.)
7. *Sorex fimbripes* Bachman, Jour. Acad. Nat. Sci. Phila., VII, Part II, p. 391, Pl. XXIV, fig. 8. (Drurys Run, Pennsylvania.)
2. *Amphisorex lesueuri* Duvernoy, Magasin de Zoologie, Mamm., p. 33, Pl. L. (Wabash River, Indiana.)
2. *Sorex platyrhinchus* Linsley, Sill. Am. Jour. Sci., XLIII, p. 346. (Stratford, Conn.)
2. *Otisorex platyrhinus* De Kay, Zoology of New York, I, p. 22, Pl. V, fig. 1. (Tappan, Rockland County, N. Y.)
7. *Sorex platyrhinus* Baird, Mamm. N. Am., p. 25. (Mass. and Vermont to Ohio.)
7. *Sorex cooperi* Baird, Mamm. N. Am., p. 27. (Labrador to Massachusetts, Illinois, and Nebraska.)
7. *Sorex haydeni* Baird, Mamm. N. Am., p. 29. (Fort Union [now Fort Buford], N. Dak.)
7. ?? *Sorex personatus* Baird, Mamm. N. Am., p. 30. (Washington, D. C.)

1890. *Sorex personatus* Dobson, Mon. Insectivora, Part I
(Ottawa); Pl. XXIII, fig. 10. (Manitoba.)
1890. *Sorex richardsoni* Dobson, Mon. Insectivora, Part I
(Halifax, Nova Scotia.)
1890. *Sorex haydeni* Dobson, Mon. Insectivora, Part III, 1
1891. *Sorex idahoensis* Merriam, North American Fauna, 1

Type locality.—United States.

Geographic distribution.—Northern North An
to the Pacific. In the eastern part of its range
in the Boreal zone, Transition zone, and locally i
of the Upper Austral zone.

General characters.—*Sorex personatus* is one
occurring in the eastern United States. It
S. longirostris, from which, while not differin
readily distinguished by its slender muzzle as
acters.

Color.—Dorsal surface of body sepia tinged
lumbar region, and sides of head, fading on
belly, throat, and chin silvery smoke gray or
sharp line of demarcation between color of bell
taking place rather abruptly. Throughout tl
slate color at base. On the back, especially jus
the fur is usually a little intermixed with g
bicolor, brownish dorsally, paler ventrally. Do
Isabella color.

Skull.—The skull of *Sorex personatus* (Pl. V
distinguishable from that of the European *Sore*
As in the latter, the brain case is moderately
the rostrum slender. The palatal depth at m
less as compared with the cranial depth in
minutus group than in those of the *araneus*
seen in comparison of the skulls of *S. person*
(see table, page 43).

Teeth.—The teeth of *Sorex personatus* very cl
S. minutus, the only differences being in the
premolar and in the form of the excavations o
of the upper molariform teeth. The first prer
minute and often scarcely visible from the oute
tus it is nearly as large as the canine. The de
vations on the posterior borders of the upper
the middle of the tooth in *S. minutus*, while in
ried farther toward the inner edge. The unv
S. personatus (Pl. IV, figs. 1, 5, 6, and 7) vary co
mentation and relative size. The first, second,
ever, diminish gradually in size, while the fifth i
incisor is usually slightly larger than the secon
than either the fourth incisor or the canine. Tl

anine may be exactly the same size, or the latter slightly the smaller. The fourth incisor, however, is very rarely smaller than the canine (cf. S. *longirostris*). Occasionally the second incisor is the largest, the three ucceeding teeth each slightly and uniformly smaller than the one before. Again, the second and third incisors may be equal and considerably rger than the fourth incisor or the canine, which in their turn are f approximately equal size.

The unicuspid teeth are usually about as broad as deep when viewed profile (Pl. IV, figs. 5, 6, and 7). Occasionally, however, they are istinctly deeper than broad, and the whole row of unicuspids is a ttle shortened (Pl. IV, fig. 1). These differences appear to be in no ay correlated with geographic distribution, specimens with the narow, deep teeth occurring at Montauk Point, New York, Roan Mountin, North Carolina, and South Edmonton, Alberta. The cusps and idges on the teeth of *Sorex personatus* are moderately tipped with light eddish brown. This brown tipping is variable both in extent and in epth of color (cf. fig. 1 with figs. 5, 6, and 7, Pl. IV). Like the variaons in form of the unicuspid teeth, the character of the pigmentation a purely individual matter.

Measurements.—Twelve adults from Nantucket Island, Massachuetts, average: Length, 100.8 mm.; tail vertebræ, 38.6 mm.; hind foot, 2.2 mm. Four specimens from North Truro, Mass., average: Length, 7.2 mm.; tail vertebræ, 37.2 mm.; hind foot, 11.35 mm. Two males om Mount Washington, New Hampshire (5,300 feet): Length, 105 m.; tail vertebræ, 41 mm.; hind foot, 12.8 mm.; and, length, 106 mm.; il vertebræ, 41.4 mm.; hind foot, 11.6 mm. Six specimens from teele County, Minn., average: Length, 87.5 mm.; tail vertebræ, 33.5 m.; hind foot, 11.1 mm. Two males from South Edmonton, Alberta, easure, respectively: Length, 94 mm.; tail vertebræ, 37 mm.; hind ot, 11 mm.; and length, 92 mm.; tail vertebræ, 36 mm.; hind foot, 1 mm.

General remarks.—Among the Shrews of the eastern United States *orex personatus* is distinguished by its small size from all but *S. longiostris* and *S. hoyi*. From both of these it differs so widely in cranial haracters that no detailed comparison is needed.

In color average *Sorex personatus* are exactly like two English speciens of *S. minutus*, but I have seen too few skins of the latter to know hether this remarkable agreement is constant. *Sorex minutus* is readily istinguished from *S. personatus* by its very large fifth unicuspid tooth.

Sorex personatus varies considerably in color, winter specimens sually being darker and more strongly tinged with chestnut than hose taken in midsummer. Sometimes there is a faint line of demaration between the darker chestnut-tinged sepia of the back and the lear paler sepia of the sides, the latter again shading abruptly into he color of the belly. The color pattern so produced is similar to hat of *S. araneus* and *S. richardsoni*, but is never so striking and well marked as in typical specimens of these animals. Individuals now an then occur with the whole pelage suffused with chestnut, but these a rare.

Specimens from the plains are paler than the average, but wheth these represent a distinct local race it is at present impossible to sa Should the plains animal prove to be separable, it must take the nan *haydeni* Baird.

Table of average cranial measurements and ratios.

Name.	L[illegible]	[illegible]ns.	[illegible]ex-[illegible]	Breadth of cranium.	Greatest antorbital breadth.	Length of bony palate.	Ratio to total length.			Ratio of antorbital breadth to palatal length.	Ratio of antorbital breadth to cranial [illegible]
							Of cranial breadth.	Of antorbital breadth.	Of palatal length.		
Sorex hoyi	Elk Riv[illegible]	[illegible]	[illegible]	6.5	4.1	5.2	45.14	28.47	36.09	78.84	61.
Sorex palustris....	......do	[illegible]	[illegible]	10.6	6.7	8.4	52.2	33.09	40.95	80.95	[illegible]
Sorex albibarbis....	Elizabe[illegible]	[illegible]	[illegible]	10.3	6.26	8.3	51.5	31.3	41.3	75.79	[illegible]
Sorex araneus	New Forest, [illegible]	[illegible]	—	9.4	5.2	7.5	51.3	28.4	40.9	66.56	55.
Sorex richardsoni	Elk River, Minn	10	18.4	9.5	5.3	7.6	51.79	28.18	41.24	69.65	55.
Sorex fumeus	Peterboro, N. Y	6	17.3	8.9	5.1	6.9	51.76	29.47	39.88	73.91	52
	Elizabethtown, N. Y	8	17.8	9.1	5.1	7	51.12	28.65	35.35	72.85	56
Sorex longirostris ..	Raleigh, N. C........	4	14.7	7.5	4.4	5.6	51.02	27.21	38.09	78.65	[illegible]
Sorex personatus	Nantucket, Mass	10	15.2	7.8	4	6.1	51.31	26.31	41.31	64.61	[illegible]
	Elk River, Minn	8	15.3	7.7	4.3	6	49.9	27.5	39.42	71.26	55.

NOTE.—The material on which *Sorex fisheri* Merriam from Dismal Swamp, Virgin (North American Fauna, No. 10, p. 86), is based came to hand too late for descriptio in this paper. The teeth of a specimen at first supposed to be an unusually lar *Sorex longirostris* are, however, figured in Plate IV.

SYNOPSIS OF THE AMERICAN SHREWS OF THE GENUS SOREX.

By C. Hart Merriam.

The object of the present paper is to furnish descriptions, on a com-
non plan, of the principal types of American Shrews. Hence the mul-
plication of closely related forms has been avoided, and several fairly
ell marked subspecies have been allowed to go unnamed. Forty-one
pecies and subspecies are here recognized, of which number 33 belong
o the restricted genus *Sorex*, 1 to the subgenus *Microsorex*, 4 to the
ubgenus *Neosorex*, and 3 to the subgenus *Atophyrax*. The subgenera
re restricted to the northern United States and Canada, while *Sorex*
roper ranges from the Arctic Circle to Guatemala. The genus as a
hole is clearly of boreal origin, and, excepting the austral *Sorex longi-
ostris* and its relative *S. fisheri*, all of the southern forms are confined
o high mountains.

The collection of mammals made by the Division of Ornithology and
Iammalogy of the Department of Agriculture contains about 1,200
pecimens of long-tailed Shrews (genus *Sorex*). In studying this mate
rial and mapping the geographic distribution of the various species,
0 new forms were discovered and are here described. Four of these
re from Alaska, 1 from British Columbia, 4 from Mexico, and 11 from
e United States.

All American Shrews have two pelages, which may be roughly desig-
ated as summer and winter coats, though by no means corresponding
rictly with these seasonal limitations. As usual among small mam-
als, the molt takes place at different dates among individuals of the
me species, so that it is not rare to capture specimens in different
lages on the same day. The winter pelage is usually plumbeous,
usky, or ash gray; the summer pelage sepia brown or chestnut. In
me species, as *Sorex trowbridgii*, the change of color is slight and
nimportant; in others, as *S. vagrans* and *S. personatus*, the difference
striking.

In defining the various species, cranial characters have proved serv
eable and dental characters indispensable. The most useful cranial
haracters are the size and form of the brain case, breadth of the
alate, length and degree of attenuation of the rostrum, and in some
ses the breadth of the interorbital constriction. The most important
ntal characters are the size and depth of emargination of the molari-
rm teeth and the proportions of the unicuspidate teeth.

In studying the skulls and teeth of Shrews it is absolutely essential
take into account changes due to age and wear. Old and young
ulls of the same species from the same locality differ surprisingly in
e, form, and massiveness. With increasing age the cranium as a

whole becomes broader, shorter, and flatter, and in some species a l sagittal ridge is developed. The brain case and palate broaden me urably, and the arch of the brain case falls away. The molar te wear obliquely, so as to take on an appearance of greater breadth, the long middle incisors not only wear off in front but turn down right angle to the cranial axis (see Pl. XI). Hence, in compar skulls and teeth of related forms it is of the utmost importance to specimens of approximately the same age.

Much labor has been expended upon the plates of Shrew teeth t accompany this paper, but they are not camera lucida drawings can not be relied upon for small details.

List of American forms of Sorex, with type localities and number of specimens exam

	Name.	Type locality.
1	*Sorex personatus*	Eastern United States (exact locality unknown).
2	*streatori* nob	Yakutat, Alaska
3	*obscurus*	Salmon River Mountains, Idaho
4	*ventralis* nob	Cerro San Felipe, Oaxaca, Mexico
5	*longicauda* nob	Wrangel, southeast Alaska
6	*alascensis* nob	Yakutat Bay, Alaska
7	*oreopolus*	Sierra Nevada de Colima, Jalisco, Mexico
8	*richardsoni*	Probably plains of Saskatchewan, Canada.
9	*sphagnicola*	Fort Liard, British Columbia
10	*fumeus*	Peterboro, Madison County, N. Y.
11	*vagrans*	Shoalwater Bay, Washington
12	*dobsoni*	Saw Tooth Mountains, Idaho
13	*monticola*	San Francisco Mountain, Arizona
14	*amœnus* nob	Mammoth Pass, Sierra Nevada, Calif
15	*vancouverensis* nob	Goldstream, Vancouver Island, B. C.
16	*orizabæ* nob	Mount Orizaba, Puebla, Mexico
17	*nevadensis* nob	Reese River Valley, Nevada
18	*ornatus* nob	San Emigdio Canyon, Mount Piños, Calif.
19	*californicus* nob	Walnut Creek, Contra Costa County, Calif.
20	*tenellus* nob	Alabama Hills, Owens Valley, California
21	*nanus* nob	Estes Park, Colorado
22	*pribilofensis* nob	St. Paul Id., Pribilof Islands, Bering Sea
23	*merriami*	Fort Custer, Mont
24	*bairdi* nob	Astoria, Oreg
25	*trowbridgii*	......do
26	*montereyensis* nob	Monterey, Calif
27	*macrodon* nob	Orizaba, Vera Cruz, Mexico
28	*veræpacis*	Coban, Guatemala
29	*saussurei*	Sierra Nevada de Colima, Jalisco, Mexico
30	*caudatus* nob	Reyes, Oaxaca, Mexico
31	*longirostris*	Santee river, South Carolina
32	*fisheri* nob	Dismal Swamp, Virginia
33	*pacificus*	Mouth of Umpqua River, Oregon
	Subgenus *Microsorex*:	
34	*hoyi*	Racine, Wis
	Subgenus *Neosorex*:	
35	*palustris*	Between Hudson Bay and Rocky Mts
36	*navigator*	Probably northern Idaho[1]
37	*albibarbis*	Profile Lake, Franconia Mountains, N. H.
38	*hydrodromus*	Unalaska Id., Aleutian Islands, Alaska
	Subgenus *Atophyrax*:	
39	*bendirii*	Klamath Basin, Oregon
40	*palmeri* nob	Astoria, Oreg
41	*albiventer* nob	Olympic Mountains, Washington

[1] See page 92, footnote.

KEY TO SPECIES OF SOREX PROPER.

A. Species living north of Mexico.

Size very large (total length about 150 mm.; hind foot, 17 mm.) .... *pacificus*
Size medium or small (total length never more than 135 mm.; hind foot, 15.5 mm. or less).
Third unicuspid larger than fourth.
Size rather large (head and body about 70 mm.).
Coloration distinctly tricolor (sides different from back).
Hind foot about 14 mm.; tail about 40 mm.; skull, 20 mm ..... *richardsoni*
Hind foot about 13 mm.; tail about 35 mm.; skull, 16 mm..... *pribilofensis*
Coloration bicolor (sides same color as back).
Color plumbeous or sepia brown; pelage normal .... *fumeus*
Color almost sooty black; pelage exceedingly long............. *sphagnicola*
Size rather small (head and body about 60 mm.).
Skull short and broad; unicuspids on same plane with molars...... *merriami*
Skull long and narrow; unicuspid series strongly deflected, forming angle with molar series.
Tail about 40 mm. or less.. *personatus*
Tail 45 mm. or more... *streatori*
Third unicuspid smaller than fourth.
Hind foot about 15 mm.
Anterior unicuspids much swollen.. *bairdi*
Anterior unicuspids not much swollen.
Color dark plumbeous or sooty.............................. *montereyensis*
Color dull chestnut brown, varying to sepia brown.
Tail very long (about 60 mm.) .... *longicauda*
Tail medium (about 50 mm.) .... *alascensis*
Hind foot about 14 mm. or less.
Hind foot about 14 mm. (color dark plumbeous or sooty).......... *trowbridgii*
Hind foot about 13 mm. or less.
Sides pale; rump with a dark patch; molariform teeth broadly and deeply excavated posteriorly.................................. *ornatus*
Coloration normal; excavation of molariform teeth moderate.
Hind foot about 13 mm.
Tail less than 45 mm.. *dobsoni*
Tail more than 45 mm.. *obscurus*
Hind foot decidedly less than 13 mm.
Brain case low and flat.
Brain case broadly rounded .... *californicus*
Brain case narrow.
Hind foot more than 12 mm................................ *tenellus*
Hind foot about 10 mm.. *nanus*
Brain case normal.
Total length less than 100 mm.
Coloration tricolor; sides much paler than back......... *nevadensis*
Coloration normal; sides not paler than back.
Hind foot less than 11 mm.......................... *longirostris*
Hind foot 12 mm or more.................................. *fisheri*
Total length more than 100 mm.
Tail less than 40 mm.; color dusky or sooty................ *amœnus*
Tail more than 40 mm.
Color pale sepia brown................................. *monticola*
Color dark.
Back and sides dark brown, varying to almost russet.. *vagrans*
Back almost dusky; sides sepia brown........... *vancouverensis*

New Brunswick: St. John, 1.
Maine: South West Harbor, 2.
New Hampshire: Ossipee, 1.
Massachusetts: Wilmington, 2.
New York: Adirondacks, 2; Locust Grove, 7; Montauk Poin (Long Island), 1.
Pennsylvania: Drury Run, 3.
New Jersey: Tuckerton, 5.
North Carolina: Roan Mountain, 20.
Indiana: New Harmony, 1; North Manchester, 1.
Michigan: Ann Arbor, 4.
Minnesota: Elk River, 64; Minneapolis, 12; Tower (Vermillion I ley, 2; Browns Valley, 1.
Ontario: Rat Portage, 1; Ottawa, 1; Parry Sound, 4; Sand L
Manitoba: Carberry, 6.
Assiniboia: Indian Head, 4.
Alberta: South Edmonton, 2; St. Albert, 1; Island Lake, 1; Banf
British Columbia: Glacier, 6; Field, 3; Kamloops (Cariboo mous, 1; Mount Baker Range, 1.
Washington: Head of Lake Chelan, 1.
Montana: Fort Custer, 8; Dry Creek, 1; St. Marys Lake, 3.
Idaho: Salmon River Mountains, 4; Saw Tooth Lake, 2.
Wyoming: Big Horn Mountains, 1.
North Dakota: Portland, 2; Steele, 1; Grank Forks, 1; Bo Mountain, 1.
South Dakota: Black Hills, Custer, 2; Deadwood, 1; Vermilli

SOREX PERSONATUS STREATORI subsp. nov.

Type from Yakutat, Alaska (about latitude 59° 35′). Type, No. 73 Nat. Mus., Department of Agriculture collection. Collected J

Cranial and dental characters.—Skull small, rather slender; palate rrow and arched; anterior part of rostrum compressed and attenu- ; unicuspids decreasing in size from first to fifth. (Viewed from the e they are sometimes in pairs, first and second subequal and third d fourth subequal.) Specimens from the northern plains have the terior part of the rostrum slightly more attenuate, with the unicus- late series nearer together and more nearly parallel. The unicuspid th also are more crowded, more vertical, less imbricating, and some- at more heavily pigmented. This form was named *forsteri* by Rich- dson, but the characters are inconstant and are matched by some ecimens from the east, notably from Montauk Point, Long Island, w York.

Measurements.—Average of 8 specimens from Montauk Point, Long and, New York: Total length, 98.3 mm.; tail vertebræ, 38 mm.; hind ot, 12 mm. Average of 4 from Roan Mountain, North Carolina: Total ngth, 100.5 mm.; tail vertebræ, 41 mm.; hind foot, 12.3 mm. (For ble of measurements see p. 63.)

General remarks.—*Sorex personatus*, the common Shrew of the east- n United States, has a larger area of distribution than any other nerican species, stretching all the way across the continent from New ngland to Alaska. Throughout this wide range its variations are rprisingly slight. Certain inconstant departures have been already entioned under the skull characters. In coloration also there are ographic differences. The most marked of these is a pale form from e prairies and plains of the Dakotas. In this animal the whitish of e under parts reaches far up over the sides, and is bordered above by band of buffy, restricting the dark color of the back to a dorsal ind. This tricolor pattern is well shown in a specimen from Port- nd, N. Dak. (No. 36854, U. S. Nat. Mus.), collected October 26, 1892, by Alden Loring. This form was separated by Baird, under the name *haydeni*, and is probably entitled to recognition. Another form that ll probably require separation comes from the extreme southern limit range of the species, where it overlaps from the Transition into the pper Austral or Carolinian zone. If worthy of recognition, it will obably take the name *lesueuri*, proposed by Duvernoy in 1842 for a ecimen from Wabash Valley, Indiana. Specimens of this form are tremely rare, and have been examined from only two localities— ndy Spring, Md., and New Harmony, Ind.[1]

Specimens of *S. personatus* from the Rocky Mountains, near the east- n boundary of British Columbia (Field and Glacier), are noticeably ger and have larger skulls than those from the neighboring plains the east, in which respect they tend toward subspecies *streatori* of utheastern Alaska.

[1] Unfortunately, the skull of the specimen from New Harmony can not be found.

Maine: South West Harbor, 2.
New Hampshire: Ossipee, 1.
Massachusetts: Wilmington, 2.
New York: Adirondacks, 2; Locust Grove, 7; Montauk Point,
(Long Island), 1.
Pennsylvania: Drury Run, 3.
New Jersey: Tuckerton, 5.
North Carolina: Roan Mountain, 20.
Indiana: New Harmony, 1; North Manchester, 1.
Michigan: Ann Arbor, 4.
Minnesota: Elk River, 64; Minneapolis, 12; Tower (Vermillion La
ley, 2; Browns Valley, 1.
Ontario: Rat Portage, 1; Ottawa, 1; Parry Sound, 4; Sand Lak
Manitoba: Carberry, 6.
Assiniboia: Indian Head, 4.
Alberta: South Edmonton, 2; St. Albert, 1; Island Lake, 1; Banff, 2
British Columbia: Glacier, 6; Field, 3; Kamloops (Cariboo La
mous, 1; Mount Baker Range, 1.
Washington: Head of Lake Chelan, 1.
Montana: Fort Custer, 8; Dry Creek, 1; St. Marys Lake, 3.
Idaho: Salmon River Mountains, 4; Saw Tooth Lake, 2.
Wyoming: Big Horn Mountains, 1.
North Dakota: Portland, 2; Steele, 1; Grank Forks, 1; Bott
Mountain, 1.
South Dakota: Black Hills, Custer, 2; Deadwood, 1; Vermillion

SOREX PERSONATUS STREATORI subsp. nov.

Type from Yakutat, Alaska (about latitude 59° 35′). Type, No. 7353
Nat. Mus., Department of Agriculture collection. Collected July
C. P. Streator. Original number, 4674.

Yakutat Bay, Alaska): Total length, 106.6 mm.; tail vertebræ, ; hind foot, 12.7 mm.

l remarks.—The slight change that *Sorex personatus* undergoes ıg the continent from the Atlantic to the Pacific is surprising. 'om Montauk Point, Long Island, New York, are hardly dis-ıble from those from Yakutat Bay, Alaska, except that the ɜ somewhat larger. Externally, the difference is a little more there is a slight increase in size and in length of tail, and a larkening of the color of the upper parts as a whole.

ens examined.—Total number, 36, from the following localities eastern Alaska: Yakutat, 8; Sitka, 16; Wrangel, 7; Loring, igedo Island, 5.

ɜasurements of Sorex personatus and S. p. streatori from different localities.

	Total length.	Tail.	Hind foot.	No. of speci-mens in av-erage.
atus:				
ɔor, Mich	94.5	35.3	11.3	4
un, Clinton County, Pa	96	39.3	11.7	3
ɔn, N. J	98.6	40.6	12.8	5
: Point, New York	98.3	38	12.1	8
7, Minn	98	39.5	12.5	2
:ton, Mass	100	40.5	12	2
, Quebec, Canada	100	41	12	15
›untain, North Carolina	100.5	41	12.3	4
British Columbia *	106.4	42.2	12.8	5
River Mountains, Idaho †	95.7	40	11.7	4
lmonton, Alberta ‡	93	36.5	11	2
ɪ streatori:				
, Alaska (type locality)	106.6	45.6	12.7	8
laska	108.1	46.9	13.4	15
l, Alaska	108.1	45.5	13.2	7
Alaska	105	46	13	4

ıg toward *streatori.* † Type locality of '*idahoensis*.' ‡ Typical of '*forsteri*.'

SOREX RICHARDSONI Bach.

(Pl. IX, figs. 1, 1*a*.)

us Richardson, Fauna Boreali-Americana, 8, 1829 (Not *S. parvus* Say, 1823).
ırdsonii Bachman, Jour. Acad. Nat. Sci. Phila., VII, 383, Pl. XXIV, fig. 5,

ɔcality.—Unknown; probably plains of Saskatchewan.

ıphic distribution.—Plains of Saskatchewan and boreal parts ɜsota; limits of range unknown.

ıl characters.—Size large (hind foot, 14 mm.); tail short; animal

—Upper parts uniform dull dark brown (almost seal brown in ɪcimens), without plumbeous tinge, and free from admixture of pale-tipped hairs; sides dull fulvous or ochraceous, in strong ; under parts dark plumbeous washed with chestnut; tail

dusky above and all round at tip, pale brownish below o
thirds. In one pelage the colors are duller, the under pa
and the side stripe indistinct. Minnesota specimens ha
stripe buffy ash or with the faintest possible tinge of fulv
belly ash gray.

Cranial and dental characters.—Skull similar to that of
slightly larger (20 mm. by 9.3 mm.); rostrum and brain
constriction higher and narrower; anterior part of rostru
more pinched in laterally, making the unicuspid series
parallel; interpterygoid fossa narrower; anterior opening o
canal smaller and situate far forward, over front of m^1; lac
opening over middle of m^1 instead of over interspace bet
m^2, as in *fumeus;* molariform teeth much less deeply ex
teriorly; unicuspidate teeth very much heavier and more
lacking the distinct vertical ridge on inner side.

Measurements.—Average of 25 specimens from South
Alberta (assumed to be near the type locality): Total lengt
tail vertebræ, 40.4 mm.; hind foot, 13.9 mm. Average of
gard, Saskatchewan (near Carlton House): Total length
tail vertebræ, 41.3 mm.; hind foot, 14 mm.

General remarks.—This large saddle-back Shrew har
comparison with any other species, though specimens in th
sometimes resemble the brown pelage of *S. fumeus.* T
always be distinguished by the cranial characters above g

Specimens examined.—Total number, 114, from the followi

Manitoba: Carberry, 2.
Alberta: South Edmonton, 25; St. Albert, 31; Island Lake, near I
Assiniboia: Indian Head, 1.
Saskatchewan: Wingard, 4.
Minnesota: Bridgman, 1; Elk River, 44; Minneapolis, 3.

SOREX SPHAGNICOLA Coues.

Sorex sphagnicola Coues, Precursory Notes American Insectivorous M
U. S. Geol. and Geog. Surv., Vol. III, p. 650, May 15, 1887.
Sorex belli Dobson MS., 1885; Merriam, Proc. Biol. Soc. Wash., VII,
nudum).

Type locality.—Vicinity of Fort Liard, British Columbia
tude 60°).

Geographic distribution.—Sub-Arctic America from extre
British Columbia (and probably Alaska) to Hudson Bay.

General characters.—Size medium (hind foot 13.5 mm.); t
shorter than body without head; unicuspids large and grad
ishing (fourth smaller than third); fur remarkably long an
on back); tail large, of uniform diameter from base to tip.
haired; no fringe on feet; claws conspicuous.

Color.—Upper parts rich, dark seal-brown, almost sooty
est on rump and palest on head; color of upper parts ex
down on sides, leaving a rather narrow strip of grayish

ie belly from chin to root of tail; color of upper parts rather abruptly ifferent from that of belly; tail concolor, same color as rump.

Dental characters.—Unicuspids large and strongly imbricating; first nd second subequal; third smaller but decidedly larger than fourth. 'iewed from below, unicuspids 1 to 4 are subquadrate in outline.

Measurements (from dry skin, probably too short).—Total length, 10 mm.; tail vertebræ, 42 mm.; pencil, 6 mm.; hind foot, 13.5 mm.

General remarks.—The above description and measurements were aken by me from a specimen collected by Dr. Robert Bell on Shamattawa River, a tributary of Hayes River, Hudson Bay, and now in the luseum of the Geological and Natural History Survey of Canada, at ttawa. The specimen was compared with the type of *S. sphagnicola*, the United States National Museum, by Mr. F. W. True, Gerrit S. liller, jr., and myself. The type specimen of *sphagnicola* is in very ad condition, but we were unable to discover any character by which ie Hayes River specimen could be separated from it. The only apparnt difference is in the hairs of the under side of the tail, which in the orn specimen are much shorter and stiffer, like bristles. Precisely his difference may be seen in a series of *Sorex richardsoni* from South dmonton, Alberta, and is evidently the result of wear.

Sorex sphagnicola seems to be closely related to *S. richardsoni*, from hich it may be distinguished by the color of the sides. In *sphagnicola* he sooty black of the upper parts reaches down over the sides and ncroaches on the belly; in *richardsoni* the sides are buffy or pale fulous, in sharp contrast with the color of the back.

Dr. Bell's specimen from Hayes River, Hudson Bay, on which the bove description is based, was named *Sorex belli* by Dobson in 1885, ut his description was never published. Dr. Dobson suspected its lentity with *S. sphagnicola*, and suggested that the type specimens e compared, which has been done, with the result above stated. Dr. ell's specimen "was the 'totem' of an Indian chief from whom it was tolen, and when he missed it he went on the war path."

SOREX FUMEUS Miller.

(Pl. IX, figs. 2, 2*a*.)

rex platyrhinus Dobson, Monog. Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 5, May, 1890.

rex fumeus Miller, N. Am. Fauna, No. 10, December, 1895, pp. 50–52.

Type locality.—Peterboro, Madison County, N. Y.

Geographic distribution.—Canadian and upper part of Transition unas of eastern United States; southward in higher Alleghenies to ountains of North Carolina and Tennessee.

General characters.—Size rather large (hind foot, 13 mm.); tail rather ort; ears prominent; animal nearly concolor.

Color.—Plumbeous pelage: Upper parts dark slate color, becoming radually paler below; under parts plumbeous, more or less washed

with grayish ash; tail bicolor: dusky above, flesl
flesh color. Brown pelage: Everywhere dull che
below; tail and feet as in other pelage.

Cranial and dental characters.—Skull similar to th
but averaging slightly smaller; rostrum and brai
striction flatter and broader; interpterygoid notcl
anterior opening of infraorbital canal large and cov
of m^1; opening of lachrymal canal over interspace
(instead of over middle of m^1, as in *richardsoni*).
much more deeply excavated; unicuspids very muc
swollen, but with a well developed vertical ridge on

Measurements.—Average of 6 specimens from Pet
locality): Total length, 116 mm.; tail vertebræ, 45.
13.2 mm. Average of 4 specimens from Renovo,]
108.5 mm.; tail vertebræ, 43.5 mm.; hind foot, 12.3 ı
specimens from Lake George, N. Y.: Total lengtl
vertebræ, 47 mm.; hind foot, 13 mm.

General remarks.—*Sorex fumeus* is the larger and
two species of *Sorex* inhabiting the northeastern Un
higher Alleghenies farther south. It does not requi
with any other species. Specimens from the Adirc
tains of New England, and Roan Mountain, North (
and have higher brain cases than the typical form
York (Peterboro) and Pennsylvania (Renovo). The
species are very different and are clearly seasonal
the winter coat, the brown the summer. This is we
of 18 specimens from Roan Mountain, on the bound
Carolina and Tennessee. Eight of these are in the
and were collected from October 11 to May 3; and t
nut-brown pelage, and were collected from June 2 t

Sorex fumeus of the northeastern States resembl
the Pacific coast of Oregon and Washington in ı
color both are plumbeous or dark slate, in which pa
from all other members of the genus inhabiting t
Their skulls and teeth also are very much alike, th
has the small third unicuspid characteristic of m
Shrews. The skull of *fumeus* is somewhat the la
rows are of approximately the same length. The m
the same in both, but the premolar and unicuspids a
in *fumeus*—the premolar larger in every way and the ı
The last upper molar, on the other hand, is largest
fumeus the large premolar is much more deeply exc

Specimens examined.—Total number, 27, from the :

New York: Peterboro (type locality), 1; Lake George, :
New Hampshire: Ossipee, 1.
Pennsylvania: Renovo, 4.
North Carolina: Roan Mountain, 18.

SOREX VAGRANS Baird.

(Pl. VIII, figs. 2, 2*a*.)

Sorex vagrans Baird, Mammals N. Am., pp. 15-18, Pl. XXVI, fig. 1675, 1857. (Type from Shoalwater Bay, Washington.)

Sorex suckleyi Baird, Mammals N. Am., pp. 18-20, Pl. XXVII, fig. 1677, 1857. (Type from Steilacoom, Washington.)

Type locality.—Shoalwater Bay, Washington.

Geographic distribution.—Southern British Columbia, western Washington and Oregon, and northern California (south on the coast to Monterey and in the mountains to old Fort Crook and Cassel). Restricted to lower Boreal and upper Transition zones.

General characters.—Size small; tail medium, about equaling body without head; third unicuspid smaller than fourth.

Color.—Upper parts dark brown, varying to almost russet; under parts ashy; tail dusky above, pale below.

Cranial and dental characters.—Skull normal, presenting no marked peculiarities, and measuring about 17 mm. in greatest length (including unworn middle incisors) by 8 mm. in greatest breadth, thus being the smallest of the northwest coast Shrews. Interpterygoid fossa rather broad and short. Compared with the skull of *S. obscurus*, which it resembles closely, it averages about 1 mm. shorter, while the breadth of the brain case remains essentially the same. The upper molars and large upper premolar are decidedly smaller than in *obscurus* and this character affords the best means of distinguishing the two species.

Measurements.—Average of 20 specimens from Aberdeen, Wash.: Total length, 103 mm.; tail vertebræ, 43 mm.; hind foot, 12.3 mm.

General remarks.—*Sorex vagrans* is the common small Shrew of the northwestern coast region of the United States and southern British Columbia. In some localities it occurs with the slightly larger *S. obscurus*, from which it is not easily distinguished except by actual comparison of the molariform teeth. It is less boreal than *obscurus*, inhabiting the upper part of the Transition and lower part of the Boreal zones, while *obscurus* is exclusively boreal. In the Rocky Mountain region *Sorex vagrans* is represented by *S. dobsoni*, with which it apparently intergrades, as specimens from eastern Washington (Marshall and Wawawai) seem to be intermediate between the two.

Sorex suckleyi Baird is identical with *S. vagrans*, as I have determined by comparison of the type specimens. In describing *suckleyi* as distinct Baird was misled by an immature and defective skull (No. $\frac{1279}{3662}$, U. S. Nat. Mus.). The base of this skull is broken and foreshortened, causing the brain case to bulge laterally, and all the anterior teeth are absent, so that the skull has an abnormal appearance (roughly shown on Pl. XXVII, Hist. N. Am. Mammals). Baird's other specimen from the type locality (No. 1677, Steilacoom) is alcoholic, and its skull is normal and identical with the type of *vagrans*, and also with other specimens of *vagrans* in the Department collection from Steilacoom. Baird's alcoholic cotype (No. 1677) agrees with typical *vagrans* in size. It no measures: Total length, 95 mm.; tail vertebræ, 43.5 mm.; hind foo 12 mm.

Specimens examined.—Total number, 104, from the following localiti

British Columbia: Port Moody, 4; Sumas, 1; Mount Baker Range, 1.

Washington: Steilacoom, 4; Olympic Mountains (Lake Cushman), 11; Sa 1; Mount Vernon, 1; Hamilton, 1; Avon, 3; Aberdeen, 22; Shoalwater Bay, Easton, 3; Marshall, 7; Wawawai (5 miles northeast), 1.

Oregon: Salem, 8; Oregon City, 2; Sheridan, 2; Gold Beach, 3; Port Orfor 1; Florence, 1; Fort Klamath, 4.

California: Crescent City, 3; San Mateo, 1; Monterey, 1; Fort Crook, (inclining toward *amœnus*); Cassel, 2; Carberry ranch, 5 (intergrade wi *amœnus*).

SOREX VAGRANS DOBSONI Merriam.

(Pl. IX, figs. 8, 8*a*.)

Sorex dobsoni Merriam, N. Am. Fauna, No. 5, pp. 33–34, Pl. IV, fig. 2, August, 18
Type from Saw Tooth or Alturas Lake, east base Saw Tooth Mountains, Idaho.

Geographic distribution.—Rocky Mountain region in northern Ida and western Montana; also isolated mountains in Montana (Big Sno and Pryor mountains), Wyoming (Big Horn Mts.), and Utah (Wasat Mts.). Restricted to lower Boreal and upper Transition zones.

General characters.—Intermediate in size and cranial charact between *S. vagrans* and *obscurus;* third unicuspid smaller than four

Color.—Upper parts uniform dull sepia brown with a faint chest tinge; under parts ashy gray washed with drab; tail bicolor: d brown above, drab below. In winter pelage the upper parts are gray or ash gray with very little sepia, and the under parts are wh or nearly white.

Cranial and dental characters.—Skull and teeth similar to those *S. obscurus*, but skull slightly smaller; palate narrower; anterior p of rostrum more attenuate; unicuspid series decidedly narrow especially the first and second teeth. Compared with *S. vagrans* skull is larger, particularly the brain case; the molariform teeth a are larger.

Measurements.—Type specimen: Total length, 105 mm.; tail verteb 47 mm.; hind foot, 12.5 mm. Average of 7 specimens from type loca (east base of Saw Tooth Mountains, Idaho): Total length, 104 m tail vertebræ, 43.4 mm.; hind foot, 12.8 mm.

General remarks.—*Sorex dobsoni* is the interior form of *S. vagra* it inhabits the Rocky Mountain plateau, while true *vagrans* is confi to the coast region and Cascade-Sierra system. Intermediate sp mens have been examined from Marshall and Wawawai on the eleva sage plain of eastern Washington. Skulls of *dobsoni* from the Horn Mountains have the brain case flatter (more depressed post orly) than those from the adjacent Pryor Mountains. The latter ag with specimens from the Big Snowy Mountains in having the br case high posteriorly and the teeth heavily pigmented. The intern tions of *dobsoni* and *obscurus* are intricate and perplexing. The two animals resemble one another very closely, but no intergrades have been found, and each has, so far as known, an independent distribution. They are best distinguished by the size of the teeth, the measurements of which are given under *S. obscurus* (p. 72). In the type specimen the third unicuspidate tooth is abnormally large.

Specimens examined.—Total number, 46, from the following localities:

Idaho: Alturas Lake (type locality), 7; Mullan, 2; Osburn, 1; Cœur d'Alene, 2; Seven Devils Mountains, 1.

Montana: Pryor Mountains, 5; Big Snowy Mountains, 4; Tobacco Plains, 1; Flathead Lake, 6; Nyack, 1; Summit (Great Northern Railroad), 2; Prospect Creek, near Thompson, 3; Thompson Pass, 2.

Wyoming: Bighorn Mountains, 4; Le Barge Creek (Wyoming Range), 1.

Utah: Ogden, 4.

SOREX VAGRANS MONTICOLA Merriam.

Sorex monticolus Merriam, N. Am. Fauna, No. 3, 43-44, September 11, 1890.

Type locality.—San Francisco Mountain, Arizona (altitude, 3,500 meters—11,500 feet).

General characters.—Size, small; pelage short; third unicuspid much smaller than fourth. Similar to *S. vagrans* in size and general appearance, but color grayish brown instead of chestnut brown; teeth broader.

Color.—Upper parts pale sepia brown without chestnut tinge, under parts ashy gray; tail bicolor: brownish above, whitish beneath except near tip, which is dark all round.

Cranial and dental characters.—Skull similar to that of *vagrans*, but slightly shorter (the shortening postrostral); palate and constriction between brain case and rostrum broader; unicuspids and molariform series broader.

Measurements.—Average of 4 specimens from type locality: Total length, 108 mm.; tail vertebræ, 44.2 mm.; hind foot, 12.7 mm. Average of 4 from Chiricahua Mountains, Arizona: Total length, 110 mm.; tail vertebræ, 47.5 mm.; hind foot, 12.2 mm.

General remarks.—*Sorex monticola* is only a slightly differentiated form of *vagrans*. It is known only from the mountains of Arizona, but is likely to be found in those of northern Mexico also.

Specimens examined.—Total number, 9, from the following localities in Arizona: San Francisco Mountain (type locality), 4; Springerville, 1; Chiricahua Mountains, 4.

SOREX AMŒNUS sp. nov.

Type from Mammoth Pass, head of Owens River, east slope Sierra Nevada, California (altitude, about 10,000 feet). Type, No. [illegible], ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 22, 1891, by E. W. Nelson. Original number, 1129.

General characters.—Similar in general to *S. vagrans*, but larger; tail shorter; color widely different: sooty instead of dull chestnut brown.

specimens from Carberry
Shasta County, Calif.: Total le
hind foot, 12.3 mm.

General remarks.—This hands
by its short tail and peculiar col
as specimens from a point farther
ranch) vary from nearly as dar
Intergradation with *vagrans* may
ern Oregon. A female caught by
1891, contained 9 embryos.

SOREX VANCOU

Type from Goldstream, Vancouver Island
U. S. Nat. Mus., Department of Agric
by Clark P. Streator. Original numbe

General characters.—Similar to S
larger forefeet and much darker co

Color.—Upper parts finely mixe
prevailing on the back, the sepia
an indistinct band; under parts
and irregularly washed (in type s
due to staining. Tail very dark
round near tip; paler below on bas

Cranial and dental characters.—
S. vagrans; molariform teeth a litt
slight.

SOREX ORIZABÆ sp. nov.

Type from Mount Orizaba, State of Puebla, Mexico (altitude, 9,500 feet). Type, No. 53633, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected April 24, 1893, by E. W. Nelson. Original number, 4733.

General characters.—Size small; tail short; ears conspicuous; hind foot, 13 mm. Similar to *S. vagrans* and *monticola*, but tail shorter, coloration darker, pelage longer, with numerous long hairs on rump; molariform teeth smaller.

Color.—Upper parts finely mixed sepia brown and dusky (no chestnut tinge), darkest on posterior half of back; under parts ashy gray, sometimes faintly washed with brownish; tail bicolor: dark brown above, whitish beneath, with line of demarcation usually distinct.

Cranial and dental characters.—Skull hardly distinguishable from that of *S. monticola* (from Arizona), but molariform teeth smaller and anterior unicuspids narrower, having much less of the ridge on inner side that is so prominent in *monticola* and *vagrans*.

Measurements.—Type specimen: Total length, 103 mm.; tail vertebræ, 38 mm.; hind foot, 13 mm. Average of 7 specimens from type locality (Mount Orizaba): Total length, 99.6 mm.; tail vertebræ, 35.4 mm.; hind foot, 13 mm.

General remarks.—*Sorex orizabæ* is the smallest Shrew thus far discovered in Mexico. It is also the only one with a light belly. It belongs to the *vagrans* group, and is very closely related to *S. monticola* of the mountains of Arizona.

Specimens examined.—Total number, 18, from the following localities in southern Mexico: Mount Orizaba, Puebla (type locality), 7; Mount Malinche, Tlaxcala, 2; Cofre de Perote, Vera Cruz, 1; Salazar, Mexico, 2; north slope Volcan Toluca, Mexico, 3; Nahuatzin, Michoacan, 3.

SOREX NEVADENSIS sp. nov.

Type from Reese River, Nevada. Type, No. [illegible], ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected November 24, 1890, by Vernon Bailey. Original number, 2150.

General characters.—Size small; tail shorter than body without head; hind foot, about 12.5 mm.; coloration peculiar, indistinctly tricolor. Similar in general to *S. vagrans*, but tail shorter and color very different.

Color.—Upper parts finely mixed slate black and hoary; sides indistinctly buffy or very pale brownish fulvous; under parts hoary, without sharp line of demarcation. Ears brownish; tail sharply bicolor: dusky above and whitish below, except near tip, which is dark all round.

Cranial and dental characters.—Skull similar to that of *S. vagrans*, but slightly smaller; brain case flatter; interpterygoid fossa narrower. Teeth as in *vagrans*.

Measurements.—Average of 4 specimens from type locality: Total length, 96.5 mm.; tail vertebræ, 39 mm.; hind foot, 12.5 mm.

General remarks.—*Sorex nevadensis* is an easily recognized specie dark back, finely mixed with hoary, and indistinctly tricolor color which suggests *S. richardsoni*, serving to distinguish it from its ne allies. It is the only Shrew thus far discovered in the interior o Great Basin.

SOREX OBSCURUS Merriam.

(Pl. VIII, figs. 1, 1*a*.)

Sorex vagrans similis Merriam, N. Am. Fauna, No. 5, pp. 34–35, Pl. IV, fig. 3, A 1891. (Name preoccupied by *Sorex similis* Hensel, 1855,[1] and here chan *obscurus*.)

Type locality.—Th Salmon River Mountains, Idaho tude, 8,200 feet).

Geographic distrib h Columbia and mountains of we Washington, Idaho, Wyoming, Utah, and Colorado; along the High Si in California to Mount Whi Restricted to Boreal

General characters.- r small; tail about equal to body out head; ears incon third unicuspid much smaller fourth. Similar to *Sorex dobsoni*, but with smaller ears, broader p and broader unicuspidate teeth. Compared with *S. vagrans*, slightly larger, with longer tail and larger molariform teeth.

Color.—Upper parts uniform dull sepia brown, under parts tail bicolor: upper side concolor with back or slightly darker, side whitish. In winter pelage the upper parts are ash gray an under parts nearly white.

Cranial and dental characters.—Skull similar to that of *S. dobson* palate broader; molariform teeth larger; unicuspidate teeth bro particularly the first and second; third unicuspid decidedly sm than fourth. Compared with *S. vagrans*, the skull is slightly l (averaging 18 mm. instead of 17 mm.), with larger and heavier m form teeth (particularly the large upper premolar) and broader and second unicuspids. The actual differences in the size of the m form teeth are shown in the following table:

Mean measurements of upper molariform teeth of Sorex obscurus, dobsoni, and va

[Measurements in $\frac{1}{100}$ mm.]

Species	Locality.	Series.[a]	pm	m[1]
Sorex obscurus	Salmon River Mountains, Idaho......	400	145	140
dobsoni	Saw Tooth Mountains, Idaho	372	137	128
vagrans	Aberdeen, Wash	345	125	120

[a] From antero external angle of pm to postero external angle of m[3].

[1] Hensel, Zeitschr. der Deutsch. Geolog. Gesellsch., VII, 1855, 459. From deposits of Cagliari, Sardinia.

Measurements.—Average of 8 specimens from type locality: Total igth, 108 mm.; tail vertebræ, 46 mm.; hind foot, 12.8 mm.

General remarks.—*Sorex obscurus* is a common and widely distributed ecies, being the prevailing Shrew in southern British Columbia and rthern Washington and in the Rocky Mountains and Sierra Nevada. closely allied form (subspecies *longicauda*) occupies a narrow strip ong the Pacific coast from the mouth of the Columbia northward to 'rangel, Alaska; another (subspecies *ventralis*) inhabits the mounins of Oaxaca, in southern Mexico.

Specimens examined.—Total number, 175, from the following localities:

Idaho: Salmon River Mountains (type locality), 8; Pahsimeroi Mountains, 1; Preuss Mountains, 1.

Utah: Wasatch Mountains, 1; Provo, 1; Manti, 3.

Colorado: Longs Peak, 1; Boulder County, 8; Fort Garland, 2; 3 miles east of Cochitope Pass (Monshower Meadows), 2; Silverton, 4.

Wyoming: Yellowstone Park, 3; Bridger Pass, 2; Woods, 1.

Montana: St. Marys Lakes, 9; Bear Paw Mountains, 2; Bear Tooth Mountains, 17; Upper Stillwater, Flathead County, 1.

California (all in Sierra Nevada): Carberry Ranch, Shasta County, 1; Greenville, Plumas County, 1; Donner, 1; Pine City, east slope Mammoth Pass, 1; head San Joaquin River, 3; Bishop Creek, 5; Mineral King, 2; Sequoia National Park (Halsted Meadows), 4; Horse Corral Meadows, 3; Mulkey Meadows, 1; North Fork Kern River, 1; East Fork Kaweah River, 7; South Fork Kern River, 3; Mount Whitney, 6; Round Valley, 12 miles south of Mount Whitney, 1; Kern Lakes (Soda Springs), 1.

Oregon: Drain (not typical), 4.

Washington (inclining toward *longicauda*): Head of Lake Chelan, 4; head of Cascade River, 2; Easton, 10; Lake Cushman, Olympic Mountains, 3.

British Columbia: Nelson, 6; Ward, 1; Field, 2; Glacier, 5; Golden, 1; Kamloops (Cariboo Lake), 2; Sicamous, 1; Goldstream, Vancouver Island, 5; Comox, 1; Sumas, 2; Port Moody (nearly *longicauda*), 1.

Alberta: Henry House, 2.

an measurements of Sorex obscurus, longicauda, and alascensis, showing progressive geographic variation in size.

	Total length.	Tail	Hind foot.	No. of specimens in average
ex obscurus:	*mm.*	*mm.*	*mm.*	
Salmon River Mountains, Idaho (type locality)	108	46	12.8	8
Yellowstone Park, Wyoming	111	46.6	13	3
Bear Tooth Mountains, Montana	112	46.5	13.1	15
St. Mary Lakes, Montana	116.5	47.6	13.5	9
Easton, Wash	118.7	52.8	13.8	10
ex longicauda:				
Lake Cushman, Washington	123	53.7	13.8	4
Neah Bay, Washington	131	62	15	2
Wrangel, Alaska (type locality)	128.8	58.1	15.5	27
Loring, Alaska	129	58.1	15.3	11
ex alascensis:				
Juneau, Alaska	122.5	53.5	14.6	16
Yakutat, Alaska (type locality)	116.3	49.2	14.[illegible]	10

SOREX OBSCURUS LONGICAUDA subsp. nov.

Type from Wrangel, southeast Alaska. Type, No. 74711, ♂ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected September 9, 1895, by Clark P. Streator. Original number, 4891.

Geographic distribution.—Coast of southeast Alaska, from Wrangel southward; also coast of Washington, including Puget Sound and Skagit Valley.

General characters.—Size rather large; tail long, nearly equaling head and body; ears conspicuous. Similar to *S. bairdi* in color, length of tail, and external appearance; similar to *S. obscurus* in cranial and dental characters.

Color.—Upper parts dull, dark chestnut brown; under parts buffy ash, more or less suffused with dull, pale chestnut brown on the belly; tail bicolor: dark brown above, buffy below.

Cranial and dental characters.—Skull and teeth almost indistinguishable from *S. obscurus*, but larger; molariform teeth more deeply emarginate posteriorly, and middle upper molar narrower on inner side.

Measurements.—Average of 27 specimens from Wrangel, Alaska (type locality): Total length, 128.8 mm.; tail vertebræ, 58.1 mm.; hind foot, 15.5 mm. Average of 2 specimens from Neah Bay, Washington: Total length, 131 mm.; tail vertebræ, 62 mm.; hind foot, 15 mm. Average of 4 specimens from Aberdeen, Wash.: Total length, 122 mm.; tail vertebræ, 57 mm.; hind foot, 14.2 mm.

General remarks.—*Sorex obscurus* is a strictly boreal species, and in the United States it is exclusively a mountain animal, not descending to base level until British Columbia is reached. In the Puget Sound region, however, and along the ocean coast of Washington, and thence northerly to Alaska, it sends a representative all the way down to sea level. This representative is larger, has developed an exceedingly long tail, and has taken on certain peculiarities of coloration. It is here described as a subspecies, in the belief that intergradation with *obscurus* takes place.

Specimens examined.—Total number, 48, from the following localities:

Alaska: Wrangel (type locality), 27; Loring, Revillagigedo Island, 11.
Washington: Neah Bay, 2; Seattle, 1; Avon, 1; Hamilton, 1; Mount Vernon, 1; Aberdeen, 4.

In addition to the above, specimens more or less intermediate between *longicauda* and *obscurus* have been examined from Port Moody, British Columbia (3), and the following places in the State of Washington: Olympic Mountains (Lake Cushman), 4; head of Cascade River, 2; Easton, 10; head of Lake Chelan, 3.

SOREX OBSCURUS VENTRALIS subsp. nov.

Type from Cerro San Felipe, Oaxaca, Mexico (altitude, 10,000 feet). Type, No. 68342, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 26, 1894, by E. W. Nelson and E. A. Goldman. Original number, 6636.

General characters.—Size small; tail short; hind foot, 13 mm. Similar to *S. obscurus*, but tail shorter and coloration darker, particularly on under parts.

Color.—Upper parts finely mixed brownish (inclining to dull chestnut) and dusky, the one or the other predominating according to the pelage (the type specimen is in the brown pelage); under parts dull chestnut, passing gradually into color of sides. Tail bicolor: dusky above, soiled whitish beneath; line of demarcation usually distinct.

Cranial and dental characters.—Skull and teeth similar to those of *S. obscurus*, but molariform teeth slightly larger. The first true molar is essentially the same size in both, but the large premolar and second molar are slightly larger in *ventralis*.

Measurements.—Type specimen: Total length, 104 mm.; tail vertebræ, 37 mm.; hind foot, 13 mm. Average of 7 specimens from type locality: Total length, 105.4 mm.; tail vertebræ, 37.3 mm.; hind foot, 13 mm.

General remarks.—It is interesting to find the common boreal Shrew of British Columbia and the northern Rocky Mountains ranging southward, in a very slightly modified form, all the way to the mountains of extreme southern Mexico.

The 7 specimens from the type locality (Cerro San Felipe) were collected August 26 to September 1, and are about equally divided between the two pelages. The 9 from the mountains west of Oaxaca were collected September 12 to 18, and all are in the dark pelage.

Sorex obscurus ventralis differs from *S. oreopolus* much as it differs from typical *obscurus*, in having the under parts dull chestnut instead of ashy gray. The skull is broader and much shorter (particularly the brain case) and the second upper molar is broader.

Specimens examined.—Total number, 21, from the following localities, all in the State of Oaxaca, Mexico: Cerro San Felipe (type locality), 7; mountains 15 miles west of Oaxaca City, 9; mountains near Ozolotepec, 3; near Cajones, 2.

Mean measurements of Sorex obscurus ventralis from different localities in Oaxaca, Mexico.

Locality.	Total length.	Tail.	Hind foot.	No. of specimens in average.
	mm.	*mm.*	*mm.*	
Cerro San Felipe, Oaxaca, Mexico	105.4	37.3	12.9	7
Mountains 15 miles west of Oaxaca City, Oaxaca	105.3	41.2	13.7	9
Mountains near Cajones, Oaxaca	106	41	13.5	2
Mountains near Ozolotepec, Oaxaca	112	40	13.3	3

SOREX OBSCURUS ALASCENSIS subsp. nov.

Type from Yakutat Bay, Alaska. Type, No. 73539, ♀ yg. ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 10, 1895, by C. P. Streator.

General characters.—Size large; tail medium, about equal to body without head; hind foot nearly 15 mm. Similar to *S. obscurus*, but larger; similar to *S. longicauda*, but tail shorter; similar to *S. fumeus* of the northeastern United States, but third unicuspid decidedly smaller than fourth, as in most west American Shrews, and color different.

Color.—Upper parts uniform sepia brown, finely mixed with light-tipped hairs; under parts ash gray, the plumbeous showing through. Tail bicolor: above, dark brown; below, whitish; tip usually dusky all round.

Cranial and dental characters.—Skull similar in size and general characters to that of *S. fumeus*, from which it differs in the following points: Brain case shorter, somewhat more inflated above plane of rostrum, and slightly narrower; palate and postpalatal notch slightly narrower; first and second unicuspids more swollen; third much smaller than fourth; second upper true molar less deeply excavated posteriorly and shorter on lingual side. The rostrum, palate, and teeth are essentially the same as in *fumeus*, except that the third unicuspid is smaller than the fourth, as usual in western Shrews. The skull and molariform teeth of *Sorex alascensis* are decidedly larger than those of *S. obscurus* and smaller than those of *S. longicauda*. Compared with *S. obscurus* the difference in size of cranium is due almost wholly to the great development of the brain case, which in *alascensis* is not only larger in every way but is more highly inflated above the plane of the rostrum.

Measurements.—Type specimen: Total length, 115 mm.; tail vertebræ, 45 mm.; hind foot, 14.5 mm. Average of 10 specimens from type locality (Yakutat, Alaska): Total length, 116 mm.; tail vertebræ, 49 mm.; hind foot, 14.8 mm.

General remarks.—Externally *Sorex alascensis* resembles *S. longicauda* except that its tail is much shorter. This difference is well shown in the table of measurements given under *S. obscurus* (p. 73).

The type locality of *alascensis* is Yakutat, Alaska; the type locality of *longicauda* is Wrangel, Alaska. Juneau is intermediate in geographic position between Yakutat and Wrangel, and its Shrews of the *obscurus* group are, as might be expected, intermediate between *alascensis* and *longicauda*. A series of 16 specimens from Juneau differs from the Yakutat series in having the tail longer (averaging 53.5 mm. instead of 49.2 mm.), the ear slightly longer, the mddle upper molar less emarginate posteriorly, and the color more inclining to rufous (particularly in No. 74386, in which the upper parts are much darker and more rufous and the under parts strongly washed with the same color). But the difference in color is probably seasonal, as a few of the specimens which are still in summer pelage (as No. 74397) are like those om Yakutat. The Yakutat specimens were collected in July; the uneau series about the middle of August. It is probable that comlete intergradation exists between *alascensis* and *longicauda.*

SOREX OREOPOLUS Merriam.

(Pl. VIII, figs. 4, 4*a*.)

Sorex oreopolus Merriam, Proc. Biol. Soc. Washington, VII, 173, September 29, 1892.

Type locality.—North slope Sierra Nevada de Colima, Jalisco, Mexico altitude, 10,000 feet).

General characters.—Size medium; tail and ears short; hind foot, 3 mm. Similar to *S. obscurus*, but tail much shorter; color much darker bove and below; skull very much longer and more slender.

Color.—Upper parts finely mixed sepia brown and dusky, without hestnut tinge; under parts drab; tail bicolor: dusky above and all ound at tip, soiled whitish beneath.

Cranial and dental characters.—Skull similar to those of *S. obscurus* and *ventralis*, but much longer and more slender, with brain case and onstriction between brain case and rostrum especially elongated, and alate narrower. The second upper molar is narrower (inner side horter) than in *ventralis.*

Measurements.—Average of 3 specimens from type locality: Total ength, 104.7 mm.; tail vertebræ, 36.3 mm.; hind foot, 13.7 mm.

General remarks.—*Sorex oreopolus* has apparently the most restricted distribution of any Mexican *Sorex*, being known only from the Sierra Nevada de Colma, Jalisco. It belongs to the *S. obscurus* group, and is epresented in the mountains of Oaxaca by a closely related form, *S. obscurus ventralis*, from which it may be distinguished by its much aler under parts, the absence of chestnut tinge from the sides and ack, and the very much longer and more slender skull, as already ointed out.

Specimens examined.—Total number, 3; all from the type locality.

SOREX BAIRDI sp. nov.

(Pl. VII, figs. 3, 3*a*.)

Type from Astoria, Oregon. Type, No. $\frac{?}{?}$, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 2, 1889, by T. S. Palmer. Orig. No. 270.

Geographic distribution.—Coast of Oregon at mouth of Columbia River.

General characters.—Size, rather large; tail long; color dull brownish chestnut; external appearance as in *S. longicauda*, but skull larger and anterior unicuspids much more swollen.

Color.—Upper parts dull, dark chestnut brown; under parts dull hestnut brown (similar to back, but lacking the admixture of blacktipped hairs); tail bicolor: dark brown, almost dusky above; flesh olor, or pale buffy brownish, below.

Cranial and dental characters.—Skull similar to that of *obscurus*, but larger (averaging 20 mm. in length and 9 mm. in breadth); first and second unicuspids very large and broad, differing markedly from any known species.

Measurements.—Average of 9 specimens from type locality: Total length, 129 mm.; tail vertebræ, 57 mm.; hind foot, 15.1 mm.

General remarks.—After *Sorex pacificus*, *S. bairdi* is the largest of the west American Shrews of the restricted genus *Sorex*. Externally it resembles its geographical neighbor, *S. longicauda*, from which it differs strongly in the large size of its anterior unicuspidate teeth.

The species is remarkable in several respects. Geographically it is restricted to the coast of Oregon near Astoria, on the south side of the mouth of the Columbia River. On the north side of the river it is replaced by *S. longicauda*, a closely related species, whose affinities have been already discussed. It seems peculiarly appropriate that this large and handsome Shrew should perpetuate the name of Professor Baird, the pioneer in the study of west American Shrews.

SOREX TROWBRIDGII Baird.

(Pl. VII, figs. 4, 4*a*.)

Sorex trowbridgii Baird, Mamm., N. Am., pp. 13-15, 1857.

Type locality.—Astoria, mouth of Columbia River, Oregon.

Geographic distribution.—Western Washington and Oregon, west of Cascade Range.

General characters.—Size, rather large; tail long; ears conspicuous; color dark slate or sooty plumbeous, with no brownish or chestnut. Resembles *S. montereyensis* of California, but differs in marked cranial and dental characters.

Color.—Upper parts blackish slate or sooty plumbeous; under parts dull plumbeous; tail sharply bicolor: blackish above, whitish beneath; feet flesh color.

Cranial characters.—Contrasted with *S. montereyensis*, the only species with which it requires comparison, the skull of *S. trowbridgii* is thinner and more 'papery,' the brain case more globular, the palate much narrower. The molariform teeth and first and second unicuspids are decidedly smaller and narrower. The large upper premolar in particular is very much smaller than in *montereyensis*.

Measurements.—Average of 3 specimens from Astoria, Oregon (type locality): Total length, 121 mm.; tail vertebræ, 57.7 mm.; hind foot, 13.7 mm. Average of 5 specimens from Olympic Mts., Washington: Total length, 120 mm.; tail vertebræ, 57.8 mm.; hind foot, 13 mm.

General remarks.—*Sorex trowbridgii* may be distinguished at a glance from all other American Shrews, except the related *S. montereyensis*, by its large size, sooty plumbeous color, and long, sharply bicolor tail. The characters that distinguish it from *montereyensis* have been pointed out in the above diagnosis.

Specimens examined.—Total number, 19, from the following localities:

Washington: Seattle, 1; Steilacoom, 2; Tenino, 1; Olympic Mountains, 5; Aberdeen, 1.

Oregon: Astoria (type locality), 3; Beaverton, 1; Yaquina Bay, 1; Marshfield, 1; Siskiyou, 3.

SOREX MONTEREYENSIS sp. nov.

pe from Monterey, Calif. Type, No. ?????, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected October 1, 1891, by Vernon Bailey. Original number, 3336.

Geographic distribution.—Coast strip and Sierra Nevada of California; uth on the coast at least to Morro and San Luis Obispo; south in the erra to Sequoia National Park and East Fork Kaweah River.

General characters.—Size large; tail long; ears prominent; color sooty ack, becoming brownish in worn summer pelage. Similar to *S. trowidgii*, but with slightly larger feet, broader palate, and larger molarirm teeth.

Color.—Upper parts slate black, passing insensibly into dull plumbus brown on the belly. In worn summer pelage the back becomes ownish. Tail sharply bicolor: blackish above, whitish beneath.

Cranial characters.—Skull similar to *S. trowbridgii* but slightly avier, brain case less globular, palate and interpterygoid notch much oader. Molariform teeth and first and second unicuspids decidedly rger and broader. The large upper premolar alone is diagnostic of e species, contrasted with its small size in *trowbridgii*.

Measurements.—Average of 5 specimens from Monterey, Calif. (type ality): Total length, 120 mm.; tail vertebræ, 52.4 mm.; hind foot, .8 mm. Average of 4 specimens from Sequoia National Park, west pe Sierra Nevada: Total length, 120.5 mm.; tail vertebræ, 51.3 mm.; id foot, 14 mm.

General remarks.—*Sorex montereyensis* is the California representa- e of *S. trowbridgii* from the coast region of Oregon and Washington, d requires comparison with no other species.

Specimens examined.—Total number, 33, from the following localities California:

Coast Belt: Crescent City, 2; Eureka, 1; Nicasio, Marin County, 8; Boulder Creek, Santa Cruz County, 1; Monterey, 6; Morro, 2; San Luis Obispo, 1.

Sierra Nevada (west slope): Michigan Bluff, 1; Middle Fork American River, Eldorado County, 2; Sequoia National Park (Halsted Meadows), 5; East Fork Kaweah River, 1.

SOREX ORNATUS sp. nov.

(Pl. VIII, figs. 3, 3a.)

e from head of San Emigdio Canyon, Mount Piños, California. Type, No. ?????, ad., U. S. Nat. Mus., Department of Agriculture collection. Collected October 9, 1891, by E. W. Nelson. Original number, 1328.

Geographic distribution.—Mountains of southern California, from head Ventura River and Mount Piños easterly to San Bernardino Peak, d south through the San Jacinto range to Santa Ysabel.

General characters.—Similar to *S. californicus*, but larger, with much longer tail, larger ears and feet, and a dark rump patch.

Color.—Upper parts ash gray, becoming suddenly darker on the rump, the dark hairs forming a distinct patch or saddle on posterior half of the back, strongly contrasted with the clear gray of the shoulders and anterior part of back; under parts whitish, reaching far up on the sides. Tail indistinctly bicolor: dark above, and all round on distal half; pale below on proximal half.

Cranial and dental characters.—Skull similar to that of *californicus*, but larger and with the brain case narrower and higher. Large upper premolar decidedly larger than in *californicus;* molariform teeth very broadly and deeply excavated posteriorly.

Measurements (of type specimen in flesh).—Total length, 108 mm.; tail vertebræ, 43 mm.; hind foot, 13 mm. Average of 2 from San Bernardino Peak: Total length, 104 mm.; tail vertebræ, 42.5 mm.; hind foot, 12 mm.

General remarks.—The dark rump patch is probably a feature of the winter pelage, as it is hardly apparent in September specimens from the San Bernardino Mountains.

Specimens examined.—Total number, 7, from the following localities in southern California: Mount Piños and head of San Emigdio Cañyon, 2; near head of Ventura River, 1; San Bernardino Peak, 2; Santa Ysabel, 2.

SOREX CALIFORNICUS sp. nov.

(Pl. XII, figs. 6, 7.)

Type from Walnut Creek, Contra Costa County, Calif. Type, No. [illegible], ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected February 15, 189[illegible], by Clark P. Streator. Original number, 1583.

General characters.—Size small; tail shorter than body without head; hind foot about 11.5 mm.; ears conspicuous; skull small and flat; brain case hardly higher than rostrum.

Color.—Upper parts dark ash gray, with a decided 'pepper and salt' appearance, and sometimes washed with brownish; under parts plumbeous, tipped with whitish.

Cranial and dental characters.—Skull small and flat; brain case depressed, broadly flattened, and hardly higher than rostrum, with which it forms a nearly straight line; palate broad. Third unicuspid very small, hardly half as large as fourth. Molariform teeth similar to those of *S. vagrans*, but smaller.

Measurements.—Average of 4 specimens from Walnut Creek, California (type locality): Total length, 93 mm.; tail vertebræ, 34.5 mm.; hind foot, 11.5 mm.

General remarks.—*Sorex californicus* is the type of a new group of Shrews, previously overlooked, and easily distinguished by the flatness of the brain case. Three members of the group are here described, all of small size, namely, S. californicus, S. tenellus, and *S. nanus.*

Specimens examined.—Total number, 7, from the following localities California: Glen Ellen, Sonoma County, 1; Walnut Creek, Contra sta County (type locality), 4; Berkeley, Alameda County, 2.

SOREX TENELLUS sp. nov.

(Pl. XII, figs. 8, 9.)

pe from summit of Alabama Hills near Lone Pine, Owens Valley, Calif. Type, No. 1 2 3 5 3, ad., U. S. Nat. Mus., Department of Agriculture collection. Collected December 22, 1890, by E. W. Nelson. Original number, 131.

General characters.—Size small; coloration pale; skull flat, as in *californicus*, but smaller and much narrower.

Color.—Upper parts pale ash gray, under parts and feet white; tail color: dark above, white beneath.

Cranial and dental characters.—Skull small, slender, and very flat; ain case depressed to plane of rostrum, which is nearly horizontal; late narrow. Teeth much as in *S. californicus*.

Measurements (in flesh).—Type specimen: Total length, 103 mm.; tail rtebræ, 42 mm.; hind foot, 12.5 mm. Average of 2 specimens from hite Mountains, California: Total length, 98 mm.; tail vertebræ, . mm.; hind foot, 12.2 mm.

General remarks.—*Sorex tenellus* is a third member of the group of at-skulled Shrews comprising *S. californicus* and *S. nanus*. It differs rikingly from *californicus* in the narrowness of its skull.

Specimens examined.—Total number, 3, from the following localities southeastern California: Alabama Hills, near Lone Pine, Owens alley, 1; White Mountains, 2.

SOREX TENELLUS NANUS subsp. nov.

(Pl. VIII, figs. 5, 5a.)

pe from Estes Park, Colorado. Type, No. 73773, ♀ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected August 3, 1895, by E. A. Preble.

General characters.—One of the smallest of the American Shrews ind foot, 10 mm.). Similar to *S. tenellus*, but smaller and darker: ull more slender and teeth smaller.

Color.—Upper parts sepia brown, darkest on the back, under parts nd feet grayish ash; tail bicolor: upper side concolor with back, except t tip, which is decidedly darker, under side whitish.

Cranial and dental characters.—Skull similar to that of *tenellus*, but ven smaller and more slender; anterior part of rostrum narrower and ore attenuate; constriction less swollen; palate narrower; molariform eth smaller (especially m^1). Compared with *S. longirostris*, the whole ull is much flatter and more slender.

Measurements.—Type specimen: Total length, 105 mm.; tail verteæ, 42 mm.; hind foot, 10 mm.

SOREX MACRODON sp. nov.

(Pl. VII, figs. 2, 2a; Pl. XII, figs. 12, 13.)

Type from Orizaba, Vera Cruz, Mexico (altitude, 4,200 feet). Type, ad., U. S. Nat. Mus., Department of Agriculture collection. Collec 1894, by E. W. Nelson and E. A. Goldman. Original number, 5759

General characters.—Size rather large; ears large; tail tion dusky. Almost indistinguishable externally from *S.* with skull and teeth much larger and more massive.

Color.—Upper parts finely mixed sepia and black, the predominating, particularly on the posterior half of the parts seal brown; tail blackish above, paler beneath, wi demarcation; feet blackish.

Cranial and dental characters.—Skull large and heavy (2 with large brain case; rostrum high; anterior nares rema and with thickened borders; palate and interpterygoid Third unicuspid small, hardly half as large as fourth. teeth very large and massive.

Measurements.—Type specimen: Total length, 128 mm.; 52 mm.; hind foot, 15.5 mm. Average of 5 specimens from Total length, 125 mm.; tail vertebræ, 50.2 mm.; hind foot

General remarks.—*Sorex macrodon*, while hardly distin ternally from *S. caudatus*, may be told at a glance by th and teeth. The skull suggests that of *Blarina*, particularl size and thickened borders of the anterior nares.

Specimens examined.—Total number, 10, from the follow in southern Mexico:

Cranial and dental characters.—The skull of *S. veræpacis* I have not seen, but judging from Alston's rather poor figures it presents no unusual characters, except that the molariform series converge posteriorly, leaving the roof of the mouth broadest on the plane of the first true molar. Alston states that the first upper incisor has a well-marked internal cusp and that the canine (fourth unicuspid) is slightly smaller than the fourth incisor (third unicuspid); but Mr. Oldfield Thomas, curator of mammals in the British Museum, who has kindly reexamined the type at my request, writes me that the contrary is true. Mr. Thomas says: "*Sorex veræpacis* has the fourth unicuspid distinctly higher than the third, so Alston's description is wrong." The relations of these teeth are correctly shown in Dobson's Monograph of the Insectivora, Part III, fasc. 1, Pl. XXIII, fig. 8.

Measurements.—The measurements recorded by Alston from the mounted specimens are, approximately: Total length, 137 mm.; tail vertebræ, 51 mm.; hind foot, 13.5 mm. The measurement of the hind foot is erroneous. Mr. Oldfield Thomas finds that it measures 15.7 mm.

General remarks.—The two original specimens of *Sorex veræpacis* were brought to England from Coban, Guatemala, more than half a century ago, and are still unique.[1] The species finds its nearest relative in *S. macrodon*, of Orizaba, Mexico. Mr. Thomas, who has compared *S. macrodon* with the type of *veræpacis*, writes me that the latter is much the darker and that the third and fourth unicuspids are very different in shape.

SOREX SAUSSUREI Merriam.

Sorex saussurei Merriam, Proc. Biol. Soc. Washington, VII, 173-174, September 29, 1892.

Type locality.—North slope Sierra Nevada de Colima, Jalisco, Mexico (altitude, 8,000 feet).

General characters.—Size rather large; tail rather short (shorter than body without head); ears large; hind foot, 14.5 mm.

Color.—Upper parts finely mixed sepia brown and dusky, the dark hairs predominating over the rump; under parts drab gray on throat and breast, more or less clouded over the belly; tail dark, paler below proximally.

Cranial and dental characters.—Skull large; rostrum high and swollen; constriction broad; brain case not abruptly elevated; palate rather narrow; postpalatal notch broad; third unicuspid slightly smaller than fourth. The skull of *Sorex saussurei* hardly needs comparison with any other species. It is very much larger than any member of the *obscurus* group, and is nearly as large as *S. macrodon*. It may be known from the latter at a glance by the smaller molariform teeth and more slender anterior part of rostrum, with much smaller anterior nares.

Measurements.—Average of 2 specimens from type locality: Total length, 118.5 mm.; tail vertebræ, 47 mm.; hind foot, 14.5 mm.

[1] Since the above was printed 5 specimens have been received from Tumbala, Chiapas, Mexico.

General remarks.—The only Shrews that resemble *S. saus* nally are its subspecies *caudatus* and *S. macrodon*, from bot it differs in greater length of tail and paler color of under p

Sorex saussurei is an exceedingly interesting type, inhabit in its typical form or as subspecies *caudatus*, most of the hi tains of southern Mexico, from the volcano of Colima on t Mount Orizaba on the east. On mapping the distribution of form and the subspecies separately, it is found that the form the mountains whose watershed finds its way to the Pacific latter is confined to those on the Atlantic slope. Specimens San Felipe, Oaxaca, on the border land between the two, a diate in characters.

Specimens examined.—Total number, 24, from the following

State of Jalisco: North slope of Sierra Nevada de Colima, 2.

State of Michoacan: Nahuatzin, 5.

State of Mexico: Mount Popocatepetl, 2; Salazar, 2; North slo of Toluca, 1.

State of Morelos: Tetela del Volcan, 1.

State of Oaxaca: Mountains 15 miles west of Oaxaca City, 1; mo Ozolotepec, 4; Tlapancingo, 2; Tamazulapam, 2.

State of Guerrero: Mountains near Chilpancingo, 2 (not typical).

SOREX SAUSSUREI CAUDATUS subsp. nov.

Type from Reyes, Oaxaca, Mexico (altitude 10,200 feet). Type, No. 696 U. S. Nat. Mus., Department of Agriculture collection. Collected Oct by E. W. Nelson. Original number, 6963.

General characters.—Similar to *S. saussurei*, but tail m (averaging 57 instead of 47 mm.); hind foot slightly longe under parts darker.

Color.—Upper parts finely mixed sepia and blackish; u seal brown, passing insensibly into the color of the back; f blackish, the latter fading to brownish underneath.

Cranial and dental characters.—Skull and teeth similar *saussurei*, but averaging slightly larger, with brain case higher. Third unicuspidate tooth slightly smaller than fou

When good series of skulls are available from single lo locality (Reyes, Oaxaca): Total length, 125 mm.; tail vertebræ, 56.6 mm.; hind foot, 14.8 mm.

General remarks.—*Sorex saussurei caudatus* is simply a long-tailed form of *saussurei*, differing slightly in coloration. Its distribution is complemental to that of *saussurei*, as it inhabits mountain slopes of southeastern Mexico, while typical *saussurei* occupies the mountains of southwestern Mexico. On Mount Zempoaltepec it presents greater range of variation than elsewhere.

Specimens examined.—Total number, 41, from the following localities in southern Mexico:

Oaxaca: Reyes (type locality), 11; Totontepec, 5; Mount Zempoaltepec, 11; Cerro San Felipe, 4.
Vera Cruz: Jico, 5; Mount Orizaba, 4; Las Vigas, 1.

SOREX LONGIROSTRIS Bach.

(Pl. IX, figs. 6, 6a.)

Sorex longirostris Bachman, Jour. Acad. Nat. Sci. Phila., III, Part. II, 370–373, Pl. XXIII, fig. 2, 1837.

Type locality.—Swamps of Santee River, South Carolina.

Geographic distribution.—Austroriparian fauna of North and South Carolina, and probably Georgia and Florida also.

General characters.—Size small (hind foot, 11 mm. or less); tail shorter than body without head; ears large and conspicuous; third unicuspid smaller than fourth, as in the west American Shrews.

Color.—Upper parts chestnut brown, changing rather abruptly to color of under parts, which is ashy tinged with drab; upper side of tail dark, under side pale brownish.

Cranial and dental characters.—Skull smallest of the American species except *S. nanus*, from Colorado, with which it agrees in size and many important characters. It differs from all the other species of the genus in eastern America, and agrees with most of those from the West, in having the third unicuspid decidedly smaller than the fourth. Compared with *S. nanus* of Colorado, the whole cranium is higher; constriction broader and more swollen; palate broader and more arched; anterior part of rostrum broader, shorter, and less attenuate. Molariform teeth small and moderately excavated posteriorly; unicuspids broad and crowded; first and second subequal; third about half as large as second and decidedly smaller than fourth; fifth relatively large.

Measurements.—Average of 6 specimens from Raleigh, N. C.: Total length, 85.6 mm.; tail vertebræ, 31.9 mm.; hind foot, 10.7 mm.[1]

General remarks.—So far as I am aware, the only specimens extant of Bachman's *Sorex longirostris* are the half dozen collected at Raleigh, N. C., by H. H. and C. S. Brimley. These specimens, I am informed,

[1] For these measurements, taken in the flesh, I am indebted to H. H. and C. S. Brimley, of Raleigh, N. C.

(S. personatus).

SOREX FISHERI sp. nov.

(Pl. IV, fig. 4.)

Type from Lake Drummond, Dismal Swamp, Virginia. Type, No. 7
Nat. Mus., Dept. Agriculture coll. Collected Oct. 11, 1895, by A. K
No. 1800.

General characters.—Similar to *S. longirostris*, but larg
decidedly longer (12 mm. instead of 10.7 mm.); ears larg
duller, that of under parts less different from upper pa
ears darker; skull much larger and heavier.

Color.—Dull chestnut brown, fading to drab brown on
nose, ears, and upper side of tail very dark; under sid
brownish except at tip, which is dark all round.

Cranial and dental characters.—Skull and teeth simila
S. longirostris, but very much larger; whole cranium h
broader; molariform teeth larger throughout.

Measurements.—Type specimen: Total length, 108 mm.;
39 mm.; hind foot, 12 mm. Average of 4 specimens from
Total length, 103 mm.; tail vertebræ, 38.2 mm; hind foot

General remarks.—Unfortunately, no specimens of *S. lon*
the type locality (swamps of Santee River) are at hand
comparison has been made with specimens from Raleigh,
are assumed to be typical.

SOREX PACIFICUS Baird.

(Pl. VII, figs. 1, 1*a*.)

Cranial and dental characters.—Skull large and massive, suggesting that of *Blarina*. Brain case broad and flattened, rounded laterally. Zygomatic ridge of squamosal strongly developed, forming a horizontal shelf. First and second unicuspids subequal; third about half as large as second; fourth abruptly larger than third, but not so large as second; fifth variable, usually only slightly smaller than third, and tipped with orange.

Measurements.—Average of 10 specimens from coast of northern California and southern Oregon: Total length, 150 mm.; tail vertebræ, 63 mm.; hind foot, 17 mm.

General remarks.—*Sorex pacificus* stands alone and does not require comparison with any other species, its great size and peculiar cinnamon-rufous color serving to distinguish it at sight. Externally, when in the dark pelage, it resembles the subgenus *Atophyrax* perhaps more closely than any species of true *Sorex*.

Specimens examined.—Total number, 13, from the following localities on the Pacific Coast.

Oregon: Yaquina Bay, 1; mouth of Umpqua River (type locality), 3; Marshfield, 1; Myrtle Point, 1.

California: Crescent City, 3; Eureka (Humboldt Bay), 2; Point Reyes (Marin County), 2.

SOREX PRIBILOFENSIS sp. nov.

(Pl. IX, figs. 3, 3*a*.)

Type from St. Paul Island, Pribilof Islands, Bering Sea. Type, No. 30911, ♀ ad. Collected July 29, 1891, by C. Hart Merriam. (Alcoholic.)

General characters.—Size rather small; tail short, thick, and remarkably hairy; ears conspicuous; hind foot, 13 mm. Unicuspids greatly swollen, diminishing from before backward as in *S. personatus;* third larger than fourth. Body distinctly tricolor.

Color.—Head and a band down the back chocolate brown; sides dull ochereous buff, fading into the soiled whitish of under parts; chin, throat, and feet white; tail sharply bicolor: narrowly brown above, broadly white beneath.

Cranial and dental characters.—Skull short and thick; constriction between brain case and rostrum greatly swollen; palatopterygoids very broad. Anterior unicuspids (first, second, and third) much swollen (very broad transversely). The skull of *Sorex pribilofensis* does not require comparison with any American Shrew. Contrasted with *S. personatus*, with which it agrees in length, it is everywhere broader and heavier, the constriction between brain case and rostrum very much broader; the brain case more truncate posteriorly; the rostrum and palatopterygoids broader, and the unicuspidate teeth very much broader.

Measurements.—Type (♀ ad.): Total length, 107 mm.; tail vertebræ, [illegible] mm.; hind foot, 13.5 mm. Average of 5 specimens from type locality: Total length, 105 mm.; tail vertebræ, 34.5 mm.; hind foot, 13.2 mm.

parts, sides, and tail white or

Color (of type specimen d

gray or drab with a buffy ting

and tail whitish; the latter w

Cranial and dental characters

any known American shrew.

above plane of rostrum; const

palate remarkably broad and s

length of the molariform serie

The unicuspidate and molarifo

angle being nearly obsolete. T

slope strongly inward. The un

cal, and but slightly imbricatin

tooth; first and third subequal;

fifth minute as usual. The larg

are broadly and deeply excavate

no secondary cusp on its inner si

In some respects the skull res

ularly in the great breadth of

need comparison, the unusual br

smaller anterior nares, larger mo

S. merriami serving to distinguis

Measurements (of type specim

length, 90 mm.; tail vertebræ, 3

General remarks.—The type

able S

teeth of certain species, with a page of explanation facing each plate. (Monog. Insectivora, Part III, fasc. 1, May, 1890). The present species is named and its peculiar dentition shown in Pl. XXIII, fig. 6, of this work. But the remarkable shape of the palate and peculiarities of the skull as a whole are not shown. The skull was removed from the alcoholic specimen by Dr. Dobson, and I have sometimes wondered whether by any possible accident it could have been transposed with that of some Asiatic species, it is so very unlike all known American Shrews. When the specimen was returned the alcoholic bore my original label and number (1001), but the skull was numbered differently (1886; its proper number is 4861). Dr. Dobson afterwards wrote me that his number was an error, and that the skull belonged to my alcoholic No. 1001.

Subgenus MICROSOREX Baird, 1877.

Microsorex Baird, in Coues Precursory Notes on American Insectivorous Mammals, Bull. U. S. Geol. and Geog. Surv., III, 646, May 15, 1877. Type, *Sorex hoyi* Baird.

Geographic distribution.—Boreal zone from northern New England and the Maritime Provinces of Canada (on both sides of the St. Lawrence) westward to British Columbia. Not known to range southward on any of the mountain systems.

Diagnosis.—Teeth 32, as in *Sorex*, but third unicuspid minute, transversely elongated, and wedged in between second and fourth so as to be hardly visible (and often not visible) from outer side (see Pl. IX, figs. 5a, 5c). The ridge on inner side of first and second unicuspids tends to develop a small accessory cusp at base, just above the cingulum.[1] Brain case narrow, depressed, and much elongated (Pl. XII, figs. 4, 5). Mandible relatively short and heavy (Pl. IX, fig. 5b). The mandible, compared with that of *Sorex personatus*, is shorter and heavier, with the coronoid process upturned more nearly at right angles to the ramus. The anterior lower incisor reaches posteriorly completely under the first and second and partly under the third lateral tooth.

The subgenus is represented, so far as known, by a single species of very small size.

SOREX (MICROSOREX) HOYI Baird.

(Pl. IX, figs. 5–5c; Pl. XII, figs. 4, 5.)

Sorex hoyi Baird, Mammals N. Am., 32–33, Pl. XXVIII, 1857. (From Racine, Wis.)
Sorex thompsoni Baird, Mammals N. Am., 34–35, Pl. XXVII. (From Burlington, Vt.)

Type locality.—Racine, Wisconsin.

General characters.—Size small (hind foot 10.5 mm.); tail considerably shorter than body without head; third unicuspidate tooth minute, scarcely visible between second and fourth.

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[1] This cusplet may be seen also in *Sorex personatus*, though commonly less developed. It is figured by Miller on page 42 of this number of N. Am. Fauna (fig. 1c).

Color.—Upper parts sepia brown; under parts ashy gray, w with buffy on throat and breast, and sometimes on belly als bicolor: dark brown above, whitish beneath.

Cranial and dental characters.—Skull smallest of the known can Shrews except *S. nanus* (15.5 by 6.5 mm.[1]), and differing from the subgeneric characters already described. The brain case is low and rather narrow, the constriction relatively broad, and the r medium. Viewed from below, the sides of the rostrum converg ually, without apparent angle between the molariform and unicus series. The lower jaw is relatively large and heavy, and the sty angular process is very long. The molars do not present any m peculiarities. The unicuspids, viewed from the outer side, seem three in number, the third and fifth being so minute and interna escape notice; in fact, in some skulls they can not be seen at al the outer side. The middle incisors have a large inner lobe.

General remarks.—*Sorex hoyi* has been supposed to have restricted distribution, but the specimens secured in recent year it to range from British Columbia on the west almost to Labra the east. It is the type, and, so far as known, the sole represen of Baird's subgenus *Microsorex*, a division which in the future is to be raised to full generic rank.

The material now available is insufficient to determine whet not the British Columbia form is entitled to subspecific separati

Measurements.—Average of 3 alcoholic specimens (in good con from Elk River, Minn.: Total length, 81.7 mm.; tail vertebræ, 30. hind foot, 10.7 mm. Average of 5 alcoholic specimens from Go Quebec, Canada: Total length, 83 mm.; tail vertebræ, 32 mm. foot, 10.5 mm. A single alcoholic specimen from Fort St. James, Lake, British Columbia, measures: Total length, 88 mm.; tail ver 31 mm.; hind foot, 9.5 mm.

Specimens examined.—Total number, 23, from the following loc

Canada: Godbout, Quebec, 5; Digby, Nova Scotia, 1; Red River Sett Manitoba, 1; Fort St. James (Stuart Lake), British Columbia, 1.

Minnesota: Elk River, 11.

North Dakota: Devils Lake, 1.

New York: Locust Grove, Lewis County, 3.

Subgenus NEOSOREX Baird, 1857.

Neosorex Baird, Mammals N. Am. p. 11. Pl. XXVI, 1857. Type, *Neosorex* n Baird.

Geographic distribution.—The Sierra Nevada of California, the Mountains from Colorado northward, and boreal parts of eastern America from plains of North Saskatchewan to Minnesota, the A

[1] A very old skull from Locust Grove, N. Y., measures only 14 by 5.8 mm., the smallest Shrew skull I have ever seen. A young adult from the same l measures 15 by 6.5. mm.

dacks of New York, northern New England, and eastern Canada on both sides of the St. Lawrence.

Diagnosis.—Feet large; hind foot very long, broad, somewhat oblique, and fimbriate for swimming; toes all fimbriate, the third and fourth united at base and slightly webbed.

The known members of the subgenus are of large size (much larger than any species of true *Sorex*), have long tails, and are white underneath at least part of the year. I am not aware of any cranial or dental characters by which *Neosorex* may be distinguished from *Sorex*, although the brain case is unusually broad and broadens abruptly from the rostrum, as in *Atophyrax*.

Number of representatives.—Three members of the subgenus *Neosorex* have been described: (1) *palustris*, from the region between the Rocky Mountains and Hudson Bay; (2) *navigator*, from the Rocky Mountains and Sierra Nevada; and (3) *albibarbis*, from the mountains of northern New England and northern New York. Still another species, *Sorex hydrodromus* Dobson, from Unalaska Island, is here referred to *Neosorex*, though I have not seen specimens, and its exact affinities are uncertain.

SOREX (NEOSOREX) PALUSTRIS Rich.

(Pl. X, figs. 5-7.)

Sorex palustris Richardson, Zool. Jour., III, No. 12, p. 517, January to April, 1828.

Type locality.—Marshy places from Hudson Bay to the Rocky Mts.

Geographic distribution.—Parts of the Boreal zone from Minnesota to the east base of the Rocky Mountains.

Habitat.—Streams, lakes, and marshes.

General characters.—Size very large (total length, 155 mm. or more; hind foot, 19 to 20 mm.); tail long; coloration of body and tail sharply bicolor; unicuspids broad.

Color.—Upper parts dusky, finely mixed with hoary; under parts dull white, sometimes clouded across breast and in anal region; tail sharply bicolor: blackish above and all round near tip, white below, the white narrower than the black; feet dark on outer side, whitish on inner side.

Cranial and dental characters.—(Specimen No. 69177, ♂ ad., from South Edmonton, Alberta). Skull large (22.5 by 10.2 mm.); brain case elevated decidedly above plane of rostrum; palate and postpalatal notch rather broad. Molariform teeth large and heavy, deeply excavated posteriorly. Unicuspidate teeth only slightly imbricating, the first and second subequal and very broad (transverse diameter equal to or greater than antero-posterior); third abruptly very much smaller; fourth much larger than third and about two-thirds size of second.

Measurements.—Richardson's measurements of the species are: Total length, 155 mm.; tail vertebræ, 65.5 mm.; hind foot, 19 mm. A specimen from Edmonton, Alberta, collected by J. Alden Loring, measured in the flesh: Total length, 157 mm.; tail vertebræ, 68 mm.; hind foot, 20 mm.—a remarkably close agreement.

General remarks.—*Sorex palustris* requires comparison with two closely related forms which it separates geographically, and with both of which it probably intergrades—*S. albibarbis* of the mountains of northern New England and New York (and probably Ontario also), and *S. navigator* of the Rocky Mountains and Sierra Nevada. From the former it may be distinguished by its white belly and sharply bicolor tail at all seasons; from the latter by larger size, darker color of upper parts, and much broader unicuspids.

Specimens examined.—Total number, 9, from the following localities:

Alberta: South Edmonton, 1.
Minnesota: Tower (Vermilion Lake), 1; Elk River, 7.

SOREX (NEOSOREX) PALUSTRIS NAVIGATOR Baird.

(Pl. XI, figs. 1-6.)

Neosorex navigator (Cooper MS.) Baird, Mam. N. Am., pp. 11-12, Pl. XXVI, 1857.
Sorex palustris Merriam, N. Am. Fauna No. 5, p. 35, August, 1891. (Idaho.)

Type locality.—Unknown; probably northern Idaho.[1]

Geographic distribution.—The Rocky Mountains and outlying ranges from British Columbia to southern Colorado, and the Sierra Nevada of California south to the Sequoia National Park.

Habitat.—Mountain streams.

General characters.—Similar to *N. palustris*, but decidedly smaller; coloration more plumbeous.

Color.—Upper parts plumbeous, finely mixed with hoary; under parts varying from silvery white to dull white, often clouded across the breast and on anal region; tail sharply bicolor: dusky above and all round near tip, white below.

Cranial characters.—Skull and teeth similar to those of *palustris*, but decidedly smaller (skull of type 20.5 by 9.6 mm.); brain case flatter; palate and interpterygoid fossa narrower. Unicuspidate teeth narrow (transverse diameter much less than antero-posterior instead of greater).

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[1]Baird gave the locality of the type specimen as Fort Vancouver, Wash. But Dr. Cooper, who collected it, states: "According to the label now attached [this specimen] was found at Fort Vancouver, but I am inclined to consider this a mistake, and that it was really taken while swimming under water in a lake near the summit of the Cascade Mountains." It is evident that the type specimen, like many other alcoholic mammals collected in the early days, was not labeled until long after its capture, and that little dependence can be placed on either of the alleged localities. Furthermore, since the subgenus *Neosorex* is unknown from the Cascade region, and probably does not inhabit western Oregon or Washington, which region is occupied by the allied subgenus *Atophyrax*, it is highly improbable that the specimen came from either of the alleged localities. It agrees closely with specimens from western Montana, and probably came from some point in northern Idaho or the mountains east of Fort Colville, in extreme northeastern Washington, which region was visited by Dr. Cooper during the same expedition.

Measurements.—Baird's measurements of the alcoholic type specimen are, approximately: Total length, 127 mm.; tail vertebræ, 72 mm.; hind foot, 20 mm. The total length is much too small, due to the contraction of the body in alcohol. Average of 8 specimens from Pryor Mountains, Montana: Total length, 148.4 mm.; tail vertebræ, 71.5 mm.; hind foot, 20.4 mm. Average of 12 specimens from Cottonwood Meadows, Mount Whitney, California: Total length, 159.2 mm.; tail vertebræ, 76 mm.; hind foot, 20.2 mm.

General remarks.—*Neosorex navigator* fluctuates considerably in size in the various mountain ranges it inhabits, and seems to intergrade completely with *S. palustris.* Specimens from the Bighorn and Wind River mountains in Wyoming are fairly intermediate, and it is probable that intergrades will be found along the east base of the Rocky Mountains in Alberta. Typical *palustris* occurs on the plains at Edmonton, Alberta, while unmistakable *navigator* is found in the Rocky Mountains at Banff and Henry House, Alberta.

The palate is relatively narrower in the type specimen; broader in specimens from most parts of the Rocky Mts. and the Sierra Nevada.

Specimens examined.—Total number, 77, from the following localities:

British Columbia: Nelson, 3.

Alberta: Banff, 2; Henry House, Rocky Mountains, 1.

Montana: Pryor Mountains, 8; Upper Stillwater Lake, 1; Flathead Lake, 5; Paola (Great Northern Railroad), 1; St. Marys Lakes, 1; Bear Tooth Mountains, 1; Red Lodge, 3.

Idaho: Head of Crow Creek, 1; Head of Wood River, 1; Salmon River Mountains, 5; Birch Creek, 6; Saw Tooth Lake, 3.

Wyoming: Bighorn Mountains, 1; Wind River Mountains, 2.

Utah: Wasatch Mountains, 6; Park City, 1.

Colorado: Gold Hill, Boulder County, 2; Cochetope Pass, 1.

California (Sierra Nevada): Upper Cottonwood Meadows (near Mount Whitney), 12; Independence Creek, 2; Sequoia National Park, 3; Lone Pine, 5.

SOREX (NEOSOREX) ALBIBARBIS (Cope).

Neosorex albibarbis Cope, Proc. Acad. Nat. Sci. Phila., 188–189, 1862.
Sorex albibarbis Merriam, Proc. Biol. Soc. Wash., VII, 25, April, 1892.
Miller, Proc. Bost. Soc. Nat. Hist., XXVII, March 24, 1894.

Type locality.—Profile Lake, Franconia Mountains, New Hampshire.

Geographic distribution.—Boreal parts of eastern North America from mountains of Pennsylvania and New York northward to Labrador.

General characters.—Similar to *S. palustris* in size and general appearance, but with under parts strongly clouded with dusky.

Color.—Upper parts blackish slate very sparingly mixed with light-tipped hairs; chin whitish or grayish, rest of under parts heavily clouded with dusky, the intensity varying with the season. Tail bicolor: blackish above and all round near tip, whitish below on basal half or two-thirds.

Cranial and dental characters.—Skull and teeth similar to those of *S. palustris*, but slightly smaller. The anterior unicuspids are narrower, and the molariform teeth less deeply excavated posteriorly. skull and teeth are intermediate between *palustris* and *na*

Measurements.—Average of 2 specimens from type loc Lake, New Hampshire): Total length, 153 mm.; tail verteb hind foot, 19 mm. Average of 7 specimens from Elizabet Total length, 154.7 mm.; tail vertebræ, 71.3 mm.; hind foo

General remarks.—In winter pelage the under parts are than in summer and the resemblance to *S. palustris* is cor closer. The two may be found to intergrade in the re Lakes Huron and Superior.

Specimens examined.—Total number, 5, from the followin

New Hampshire: Profile Lake (type locality), 1.
New York: Elizabethtown (east side of Adirondacks), 2.
Pennsylvania: Bushkill Creek, Monroe County, 1.
Canada: Godbout, Province of Quebec (north shore of St. Law

SOREX HYDRODROMUS Dobson.

Sorex hydrodromus Dobson, Annals and Magazine Nat. Hist., 6th s fig., November, 1889.

Type locality.—Unalaska Island, Aleutian Islands, Alas

General characters.—Size small (hind foot, 13 mm.); larger than fourth; both fore and hind feet fringed on bot thick comb-like fringe of stiff hairs extends along the ou margins of both manus and pes, being especially den developed along the outer margins."

Color.—"Fur reddish brown above, yellowish brown be throat, and chest with grayish-tipped hairs; the base of t above and beneath dark bluish gray."[1]

Dental characters.—"The teeth closely resemble those o as in that species, the third incisor is the largest and l unicuspidate teeth; the first maxillary tooth is very ne the second incisor and quite intermediate in size between cisor and the second maxillary tooth; the third maxillary more internal than in *S. vulgaris*, in this respect resemblin can representatives of that species, and its long axis is at to the direction of the jaw, its inner and posterior convex n into the concavity on the inner and anterior sides of the lary tooth. The mandibular teeth closely resemble those of

Measurements.—"Length: Head and body, 53 mm.; t eye, from end of muzzle, 9½ mm.; ear, length, 6½ mm.; elb middle digit, without claw, 13 mm.; manus, 6 mm.; pes, of Sciences at St. Petersburg. It is the only American species of the family *Soricidæ* (except *Sorex verapacis*, from Guatemala) that I have not seen. Its position in the series is uncertain.

Subgenus ATOPHYRAX Merriam, 1884.

Atophyrax Merriam, Trans. Linn. Soc. New York, Vol. II, pp. 217-222, pl. August, 1884. Type, *Atophyrax bendirii* Merriam, from Klamath Basin, Oregon.

Geographic distribution.—The subgenus *Atophyrax* inhabits the north-west coast region from western British Columbia southward to Sonoma County, Calif. In Oregon and Washington it reaches the east base of the Cascade range; in California it is confined, so far as known, to the coast strip north of Point Reyes.

Diagnosis.—Feet large and fimbriate, with third and fourth toes of hind foot webbed at base, as in *Neosorex*. Anterior part of rostrum narrowed, much produced and decurved, forming, with the under jaw, a toothed forceps for seizing living prey. Brain case expanded laterally, as in *Neosorex*. The unicuspidate series are parallel, or nearly parallel, and in the known forms the teeth are narrow and arranged in pairs of approximately equal size—first and second subequal and largest, third and fourth subequal and smaller, the third slightly smaller than fourth. The fifth is large for a Shrew, and when unworn bears a colored cusp, which is sometimes double or bifid. The large antero-internal cusp of m^1 and m^2 rises posteriorly to form a distinct secondary cusp, not present in the other subgenera. This secondary cusp, which is diagnostic of *Atophyrax*, is separated by a sulcus from the large triangular cusp developed on the cingulum of the posterior half of the inner side of the tooth. The extreme of differentiation of the group is exhibited by *A. palmeri*, from the mouth of the Columbia River.

Number of representatives.—Three well-marked forms of *Atophyrax* are contained in the Department collection: (1) *A. bendirii*, ranging from Burrard Inlet, British Columbia, southward along the Cascade range to southern Oregon, and thence southwesterly to and along the coast of northern California; (2) *palmeri*, from the coast of Oregon at the mouth of the Columbia River; and (3) *albiventer*, from the Olympic Mountains of Washington. Still another may require subspecific recognition, namely, a form from the coast of California in Mendocino County. Additional material is necessary to determine the interrelations of the several forms.

SOREX (ATOPHYRAX) BENDIRII (Merriam).

(Pl. X, figs. 1-4.)

Atophyrax bendirii Merriam, Trans. Linn. Soc. New York, II, 217-225, Aug., 1884.
Sorex bendirii Dobson, Mon. Insectivora, Part III, fasc. I, Pl. XXII, fig. 17, and explanation (type specimen).

Type locality.—Klamath Basin, Oregon (near Williamson River, 18 miles southeast of Fort Klamath).

Geographic distribution.—Klamath Basin, Oregon, and thence north ward along east side of Cascade range to Puget Sound (Port Mood British Columbia); westward (probably through Klamath River Valle to coast of California, and southward to Sonoma County.

General characters.—Size, large (total length, 150 mm.; head an body, 82 mm.; hind foot, 20 mm.); tail long; coloration uniform soo or sooty brown, sometimes paler below.

Color.—Dull sooty plumbeous, changing in worn pelage to soo brown, faintly paler on under parts; tail dusky all round. Some of t specimens from Easton and Port Moody have the under parts decided pale, suggesting a seasonal difference.

Cranial and dental characters.—The characters by which *Atophyr* differs from *Sorex* and *Neosorex* have been given in the subgeneric dia nosis and need not be repeated here. The skull of *S. bendirii* diffe from those of *palmeri* and *albiventer*, the only other members of the su genus now known, in the following particulars: Size smaller (to length, 22.5 mm.); anterior narrow part of rostrum shorter; brain ca shorter; interpterygoid notch broader; unicuspidate series sligh more divergent posteriorly; molars narrower.

Measurements.—Type specimen (measured from alcohol, in good co dition): Total length, 150 mm.; tail vertebræ, 68 mm.; hind fo 20 mm. Average of 3 specimens from Mendocino County, Ca (measured in flesh): Total length, 150.3 mm; tail vertebræ, 69.7 mm hind foot, 19.7 mm.

General remarks.—The type of *Atophyrax bendirii* was collected Klamath Basin, Oregon, by Capt. (now Major) C. E. Bendire, and w described by me eleven years ago. The next specimens examined we from Chilliwack, British Columbia, collected by Mr. A. C. Broo Subsequently the field naturalists of the division extended the ran of the species southward along the coast of California to Gualala, a northward along the Cascade range to Port Moody, on Burrard Inl British Columbia. Two additional forms, believed to intergrade w *bendirii*, and hence treated as subspecies, have been discovered and here described: *palmeri*, a large black form from the coast of Oreg at Astoria; and *albiventer*, a white-bellied form from the Olym Mountains of Washington. In addition to these, the form from Gu lala, Calif., differs somewhat from typical *bendirii*, and if the charact shown by the only two specimens at hand prove constant, will a merit subspecific separation. The two specimens referred to dif from all other American Shrews in having the fifth unicuspidate too unusually large and with a double cusp. The peculiarity would se to be abnormal, but is constant in the two specimens examined. T unicuspidate teeth are more crowded, so that the series as a whole shorter and the cingulum does not reach so far backward. The la upper premolar and first true molar are more deeply excavated po teriorly, and the third and fourth unicuspids larger.

Specimens examined.—Total number, 21, from the following localities:

British Columbia: Port Moody, 7; Chilliwack, 2.
Washington: Easton (Cascade range), 8.
Oregon: Klamath Basin, 1 (type).
California: Mendocino County, 1; Gualala, 2.

SOREX (ATOPHYRAX) BENDIRII PALMERI subsp. nov.

(Pl. XII, figs. 1-3.)

Type **from Astoria, Oregon.** Type No. [illegible], ♀ old, U. S. Nat. Mus., Department of **Agriculture** collection. Collected July 29, 1889, by T. S. Palmer. Orig. No. 256.

Geographic distribution.—Coast of Oregon and Willamette Valley; **limits** of range unknown.

***General** characters.*—Similar to *S. bendirii*, but larger (total length, **165 mm.**; head and body, 92 mm.); blacker; skull heavier.

Color.—Upper parts glossy black, changing gradually to sooty plumbeous on under parts; tail dusky all round. The black of the upper parts is less pure on the head and shoulders, where the brownish subapical part of the fur shows through.

Cranial and dental characters.—Contrasted with *S. bendirii* the skull of *palmeri* is larger and heavier (type measures 24.5 by 11.5 mm.), with narrower interpterygoid fossa, and larger and heavier teeth. The unicuspids and molars are relatively as well as actually broader. The first unicuspid is appreciably larger than second; third and fourth subequal, but third slightly the smaller. Unicuspid series with middle incisor longer than molariform series.

Measurements.—Type specimen: Total length, 165 mm.; tail vertebræ, 73 mm.; hind foot, 20 mm.

General remarks.—A specimen from Beaverton, in the Willamette Valley, is practically indistinguishable from the type, but one from Oregon City (collected October 21) is more dark slate color without pure black.

Specimens examined.—Total number, 3, from the following localities in Oregon: Astoria (type locality), 1; Beaverton, 1; Oregon City, 1.

SOREX (ATOPHYRAX) BENDIRII ALBIVENTER subsp. nov.

Type from Lake Cushman, Olympic Mountains, Washington. Type. No. 66198, ♂ ad., U. S. Nat. Mus., Department of Agriculture collection. Collected July 7, **1894**, by C. P. Streator. Original number, 1021.

General characters.—Similar to *S. bendirii*, but larger, with tail decidedly longer, and under parts abruptly whitish; skull and teeth larger.

Color.—Upper parts sooty plumbeous; under parts abruptly white or whitish (as in *Neosorex*), clouded with dusky on breast and middle of belly. In one pelage the clouding below spreads over nearly the whole of the under parts. Tail blackish, indistinctly and narrowly paler below basally.

Cranial and dental characters.—Skull decidedly larger tha (23.5 by 10.5. mm.); molariform teeth about the same size; date teeth less crowded and series longer; second unicusp than first. The skull is intermediate in size between *be palmeri.*

Measurements.—Type specimen: Total length, 166 mm.; bræ, 78 mm.; hind foot, 20.5 mm. Average of 3 specimens locality (Lake Cushman, Washington): Total length, 160.3 vertebræ, 73.3 mm.; hind foot, 20.5 mm. One of these has a The average of the other 2 is: Total length, 165 mm.; tail 78 mm.; hind foot,

General remarks. as known *albiventer* is restrict Olympic Mountain rge feet indicate that it is mo than the other men ie group. The white of the und much more marked the Easton and Port Moody sp *bendirii*, and the ta derably longer.

ADDENDUM.

While this paper is passing through the press, a remar species of *Sorex* proper has been received from southern Mex here described.

SOREX STIZODON sp. nov

Type from San Cristobal, Chiapas, Mexico, No. 75885, ♀ ad. U. S. N. Dept of Agriculture Coll. Collected Sept. 25, 1895, by E. W. Nelson an man. Orig. No 8473.

General characters.—Similar to *S. saussurei* in external a but slightly smaller, and rump not decidedly darker than re

Color.—Upper parts finely mixed sepia brown and dus parts seal brown, passing insensibly into color of sides and indistinctly bicolor, dusky above, pale below.

Cranial and dental characters.—Skull similar to that of *s* general form, great breadth of constriction and breadth of p shorter and broader, with brain case more inflated and rostr First and second unicuspids large, the second much larger and relatively larger than in any other member of the genus me. Contrasted with *saussurei* the molariform teeth are smaller and less emarginate posteriorly. The chestnut tips teeth are reduced to a minimum and very pale.

Measurements.—The flesh measurements have not been rec the collector. The skin measures as follows: Total length vertebræ, 38; hind foot, 12.

INDEX.

[Names of synonyms are in italics.]

PLATE I.

[...able natural size.]

FIG. 1. *Bl*... Columbia, S. C.
(No. ... s.)

2–4. *Blarina bre*... Blair, Nebr. (type locality).
(No. 48830, U. S. Nat. Mus.)

5–6. *Blarina parva* (Say). Blair, Nebr.
(No. 48025, U. S. Nat. Mus.)

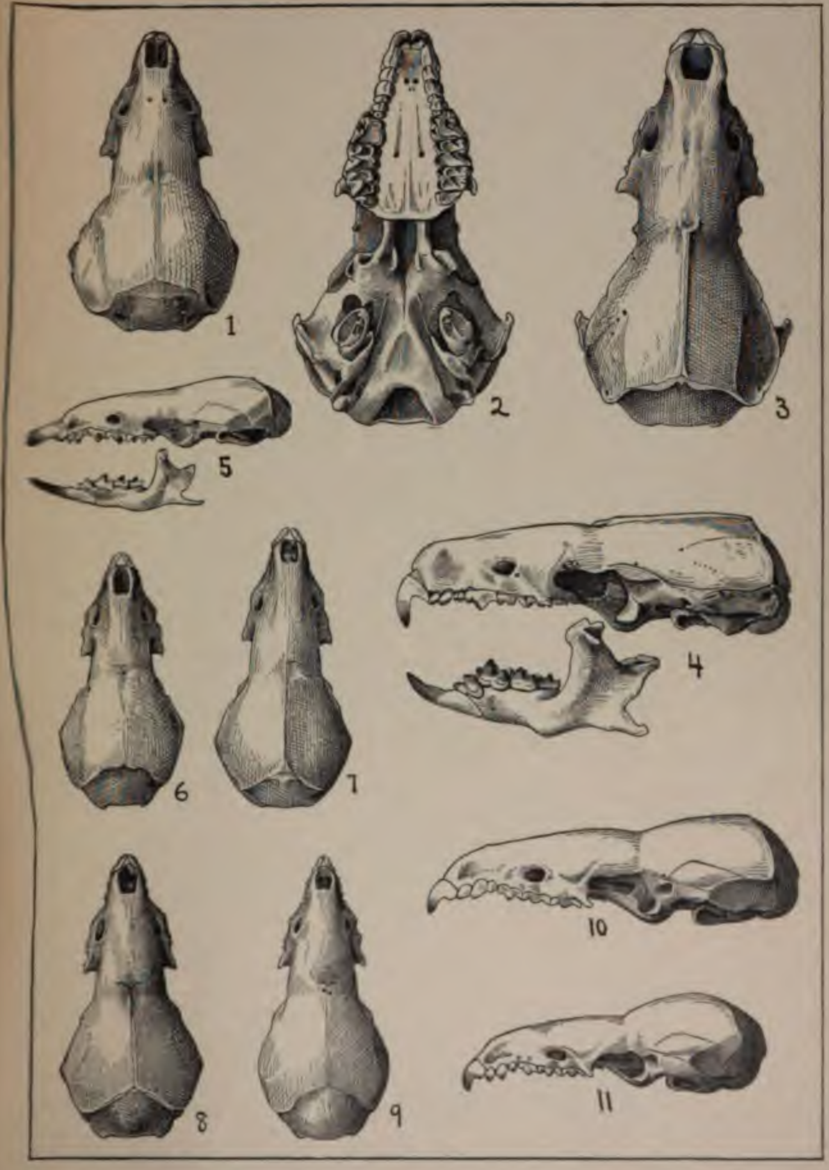
7. *Blarina floridana* nob. Canaveral, Fla.
(No. 23937, U. S. Nat. Mus.)

8. *Blarina tropicalis*. Pluma, Oaxaca, Mexico.
(No. 71452, U. S. Nat. Mus.)

9. *Blarina soricina* nob. Tlalpam, Valley of Mexico.
(No. 50761, U. S. Nat. Mus.)

10. *Blarina magna* nob. Totontepec, Oaxaca, Mexico.
(No. 68575, U. S. Nat. Mus.)

11. *Blarina mexicana* Baird. Jico, Vera Cruz, Mexico.
(No. 55083, U. S. Nat. Mus.)



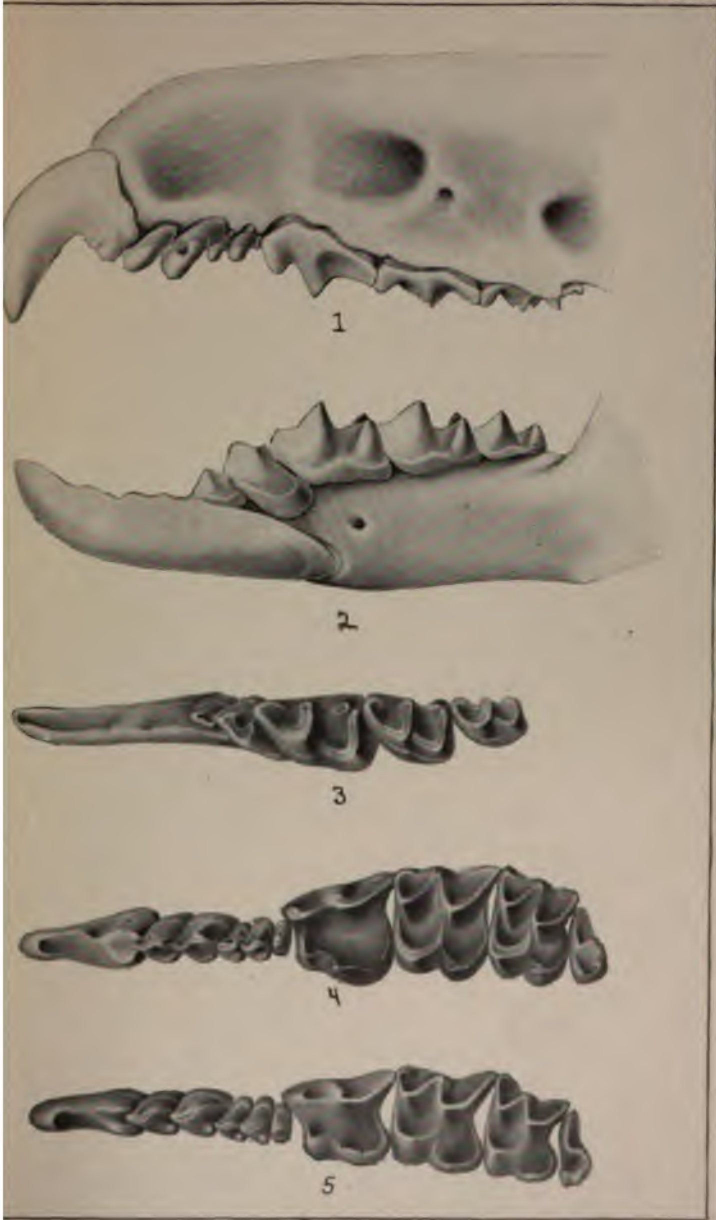
1. *Blarina carolinensis.*
2-4. *B. brevicauda.*
5, 6. *B. parva.*
7. *B. floridana.*
8. *B. tropicalis.*
9. *B. soricina.*
10. *B. magna.*
11. *B. mexicana.*

PLATE II.

rged about seven times.]

Fig. 1-4. *Blarina brevicau*). Council Bluffs, Iowa (near type lo
(No. 43765, ♀ ad., U. S. Nat. Mus.)
1. Left side of upper jaw, showing teeth.
2. Left side of under jaw.
3. Lower series of teeth, showing crowns (left side).
4. Upper series of teeth, showing crowns (left side).

5. *Blarina telmalestes* nob. Dismal Swamp, Virginia. Type.
(No. 71823, ♀ ad., U. S. Nat. Mus.)
Upper series of teeth, showing crowns (left side).



1-4. *Blarina brevicauda* (Say). Council Bluffs, Iowa.
5. *B. telmalestes* nob. Dismal Swamp, Va.

PLATE III.

[Enlarged about seven times.]

FIGS. 1, 5, 11, 12. *Blarina carolinensis.* Raleigh, N. C. (No. 3610, U. S. Nat. Mus.)

2, 6, 9, 13. *Blarina parva.* Blair, Nebr. (N. 48823, U. S. Nat. Mus.)

3, 7, 10, 14. *Blarina berlandieri.* Brownsville, Tex. (No. 48810, U. S. Nat. Mus.)

4, 8, 15. *Notiosorex crawfordi.* San Bernardino, Cal. (No. 2661, Merriam collection.)

1, 5, 11, 12. *Blarina carolinensis.* 2, 6, 9, 13. *B. parva.* 3, 7, 10, 14. *B. berlandieri.* 4, 8, 15. *Notiosorex crawfordi.*

PLATE IV.

[All magnified above ten diameters.]

FIG. 1. *Sorex personatus.* Osler, Saskatchewan, Canada.
(Collection of E. A. and O. Bangs.)

2. *Sorex longirostris.* Raleigh, N. C.
(No. 1280, collection of G. S. Miller, jr.)

3. *Sorex longirostris.* Raleigh, N. C.
(No. 1297, collection of G. S. Miller, jr.)

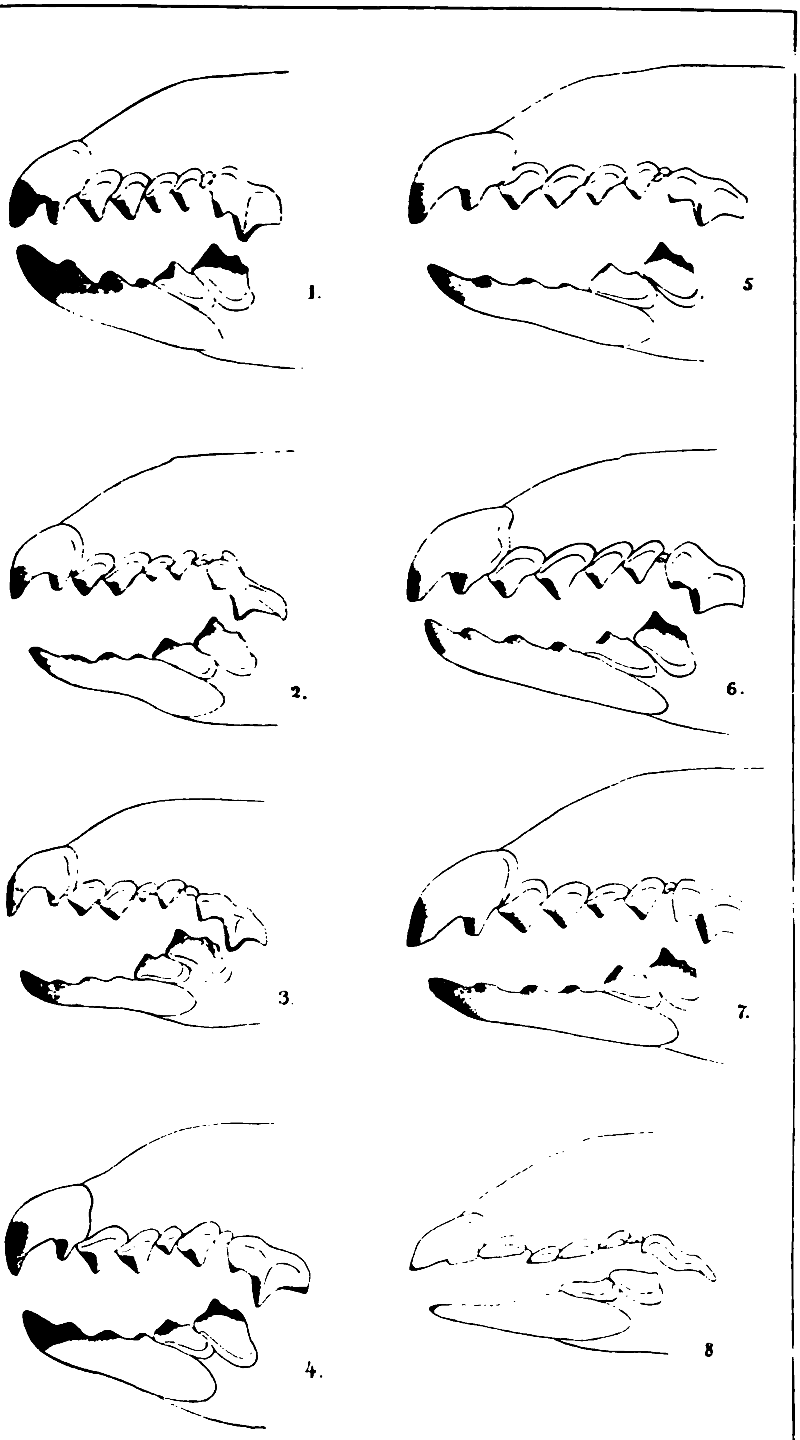
4. *Sorex fisheri.* Dismal Swamp, Virginia.
(No. 71822, U. S. Nat. Mus., Department of Agriculture collect

5. *Sorex personatus.* Victoria County, New Brunswick.
(No. 8035, Am. Mus. Nat. Hist.)

6. *Sorex personatus.* Victoria County, New Brunswick.
(No. 7994, Am. Mus. Nat. Hist)

7. *Sorex personatus.* Victoria County, New Brunswick.
(No. 8022, Am. Mus. Nat. Hist.)

8. *Sorex personatus.* Nantucket, Mass.
(No. 2153, collection of G. S. Miller, jr. Teeth very much wo

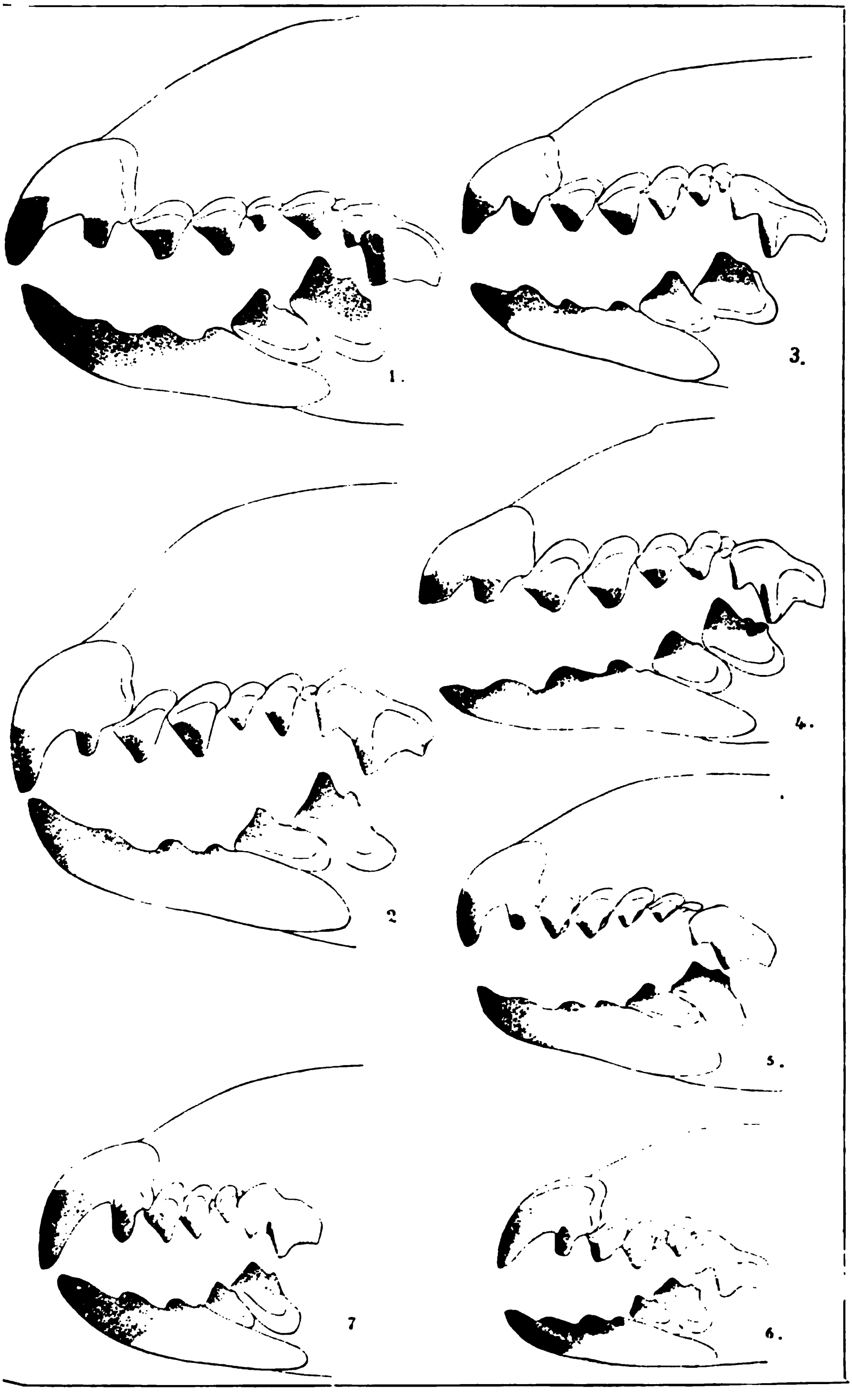


1, 5, 6, 7, 8. *Sorex personatus*. 2, 3, S. longirostris. 4. S. fisheri.

PLATE V.

[All magnified about ten diameter

FIG. 1. *Sorex palustris*. Laramie, Wyo.
(No. 54595, U. S. Nat. Mus., Department of Agriculture collectio
2. *Sorex albibarbis*. Elizabethtown, N. Y.
(No. 2428, collection of G. S. Miller, jr.)
3. *Sorex araneus*. Scotland.
(No. 3598, collection of G. S. Miller, jr.)
4. *Sorex richardsoni*. Elk River, Minnesota.
(No. 2563, collection of Dr. C. Hart Merriam.)
5. *Sorex fumeus* sp. nov. Peterboro, N. Y.
(Type, No. 2582, collection of G. S. Miller, jr.)
6. *Sorex hoyi*. Victoria County, New Brunswick.
(No. 8005, Am. Mus. Nat. Hist.)
7. *Sorex hoyi*. Elk River, Minnesota.
(No. 4353, collection of Dr. C. Hart Merriam.)



1. *Sorex palustris.*
2. *S. albibarbis.*
3. *S. araneus.*
4. *S. richardsoni.*
5. *S. fumeus.*
6, 7. *S. hoyi.*

PLATE III.

[Enlarged about seven times.]

FIGS. 1, 5, 11, 12. *Blarina carolinensis*. Raleigh, N. C. (No. 3610, U. S. Nat. Mus.)

2, 6, 9, 13. *Blarina parva*. Blair, Nebr. (N. 48823, U. S. Nat. Mus.)

3, 7, 10, 14. *Blarina berlandieri*. Brownsville, Tex. (No. 48810, U. S. Nat. Mus.)

4, 8, 15. *Notiosorex crawfordi*. San Bernardino, Cal. (No. 2661, Merriam collection.)

PLATE VII.

[Enlarged about seven times.]

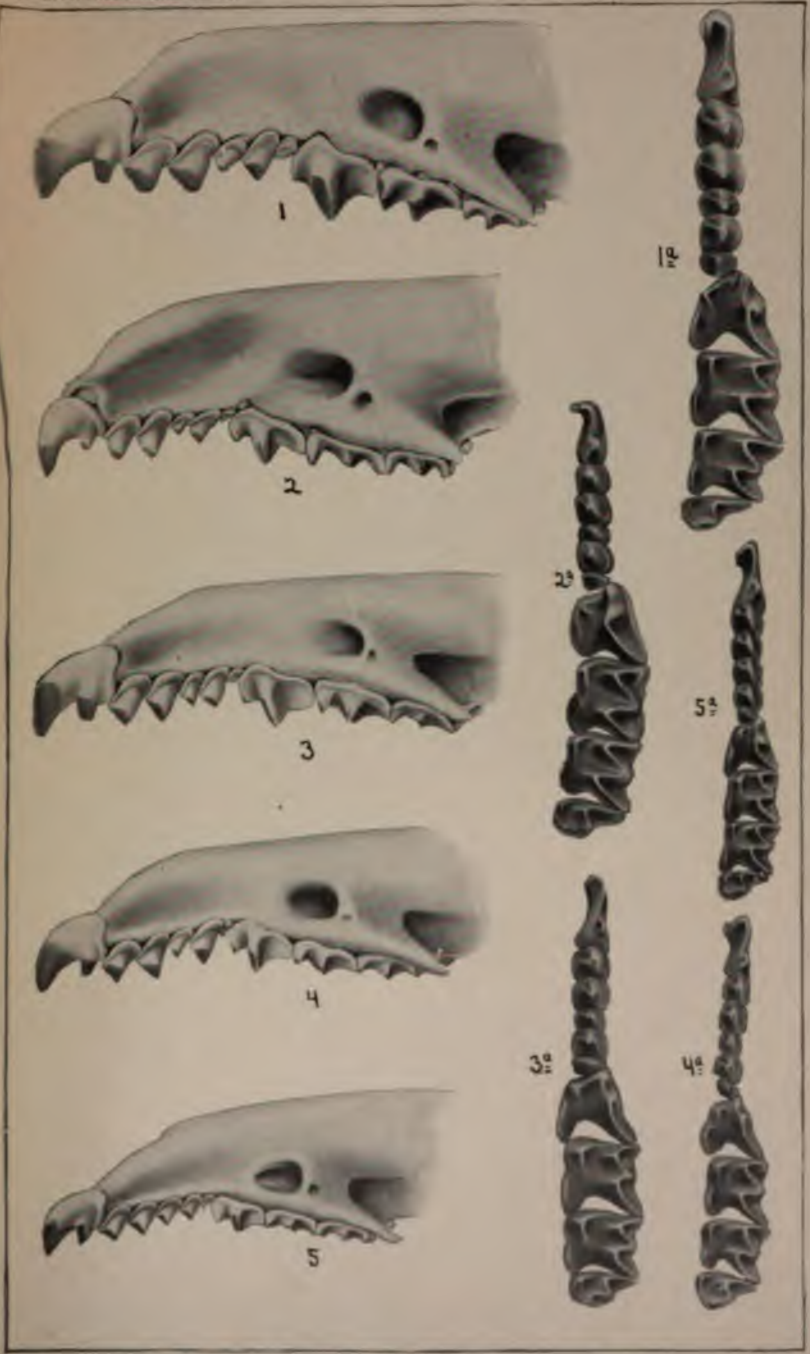
FIG. 1. *Sorex pacificus.* Crescent City, Calif.
(No. 24011, U. S. Nat. Mus.)

2. *Sorex macrodon* nob. Orizaba, Mexico. Type
(No. 58272, U. S. Nat. Mus.)

3. *Sorex bairdi* nob. Astoria, Oreg.
(No. 24318, U. S. Nat. Mus.)

4. *Sorex trowbridgii.* Astoria, Oreg.
(No. 24315, U. S. Nat. Mus.)

5. *Sorex personatus.* South Edmonton, Alberta.
(No. 69169, U. S. Nat. Mus.)



1. *Sorex pacificus.*
2. *S. macrodon.*
3. *S. bairdi.*
4. *S. trowbridgii.*
5. *S. personatus.*

PLATE VIII.

Enlarged about seven times.]

FIG. 1 River Mountains, Idaho. [Type of

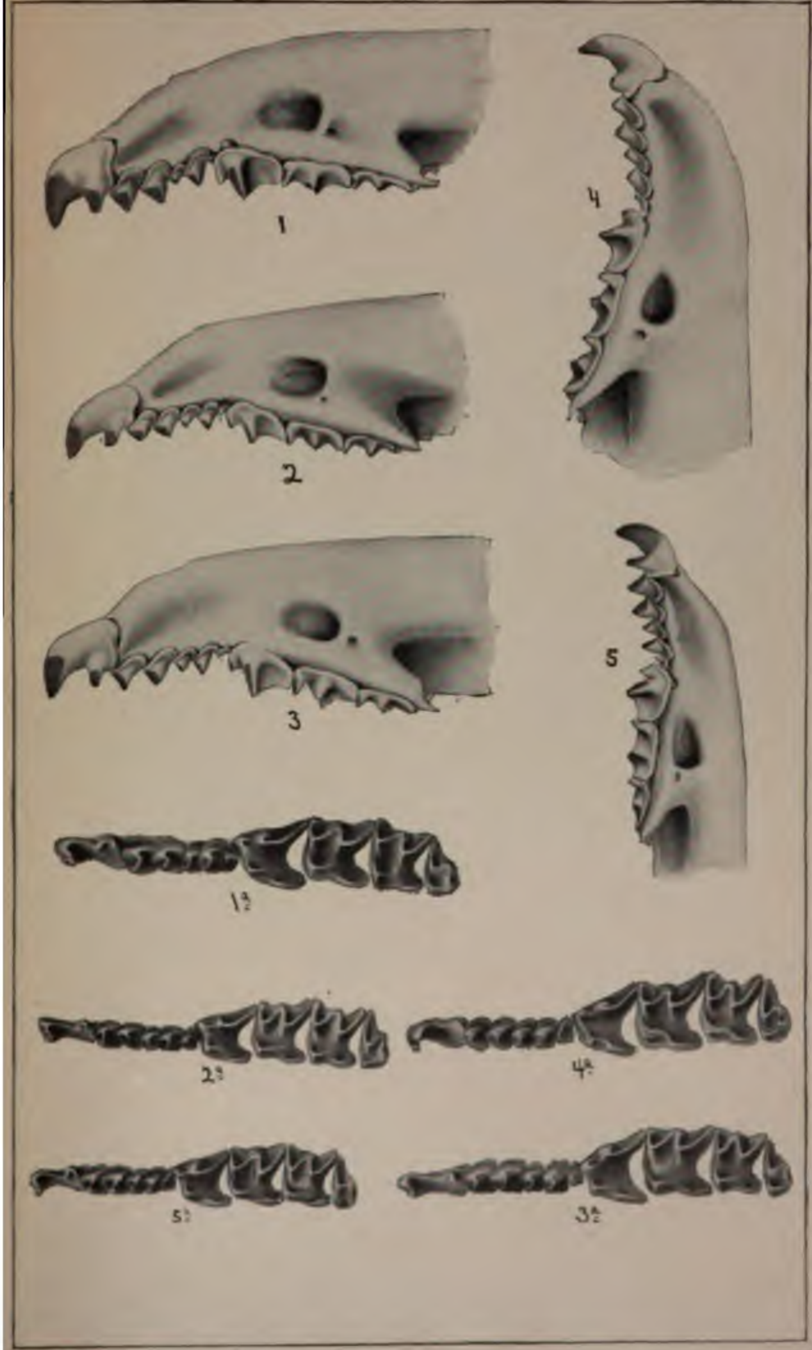
(No. 23525, ♀, Nat. Mus.)

2. *Sorex vagrans*. Aberdeen, Wash.
(No. 24322, U. S. Nat. Mus.)

3. *Sorex ornatus* nob. San Emigdio Canyon, California. Type
(No. 43198, ♂ ad., U. S. Nat. Mus.)

4. *Sorex oreopolus*. Sierra Nevada de Colima, Jalisco, Mexico.
(No. 45698, U. S. Nat. Mus.)

5. *Sorex tenellus nanus* nob. Estes Park, Colorado. Type.
(No. 73772, U. S. Nat. Mus.)



1. *Sorex obscurus.*
2. *S. vagrans.*
3. *S. ornatus.*
4. *S. oreopolus.*
5. *S. nanus.*

PLATE IX.

[Enlarged about seven times.]

FIG. lberta, Canada.

h (profile).

ies of teeth.

w York.

.)

th (profile).

ies of teeth.

and, Pribilof Islands, Bering Sea.

3. Uppe… th (profile).

3*a*. Crowns of upper series of teeth.

4. *Sorex merriami*. Fort Custer, Mont. Type.

(No. 1861, ♀, Merriam collection.)

4. Upper jaw with teeth (profile).

4*a*. Crowns of upper series of teeth.

5. *Microsorex hoyi*. Devils Lake, N. Dak.

(No. 4353, Merriam collection.)

5. Upper jaw (profile).

5*a*. Crowns of upper series of teeth.

5*b*. Lower jaw (profile).

5*c*. Second and third unicuspids greatly enlarged.

6. *Sorex longirostris*. Raleigh, N. C.

(No. 4635, ♀, Merriam collection.)

6. Upper jaw with teeth (profile).

6*a*. Crowns of upper series of teeth.

7. *Sorex personatus*. Montauk Point, New York.

(No. 56588, U. S. Nat. Mus.)

7. Upper jaw with teeth (profile).

7*a*. Crowns of upper series of teeth.

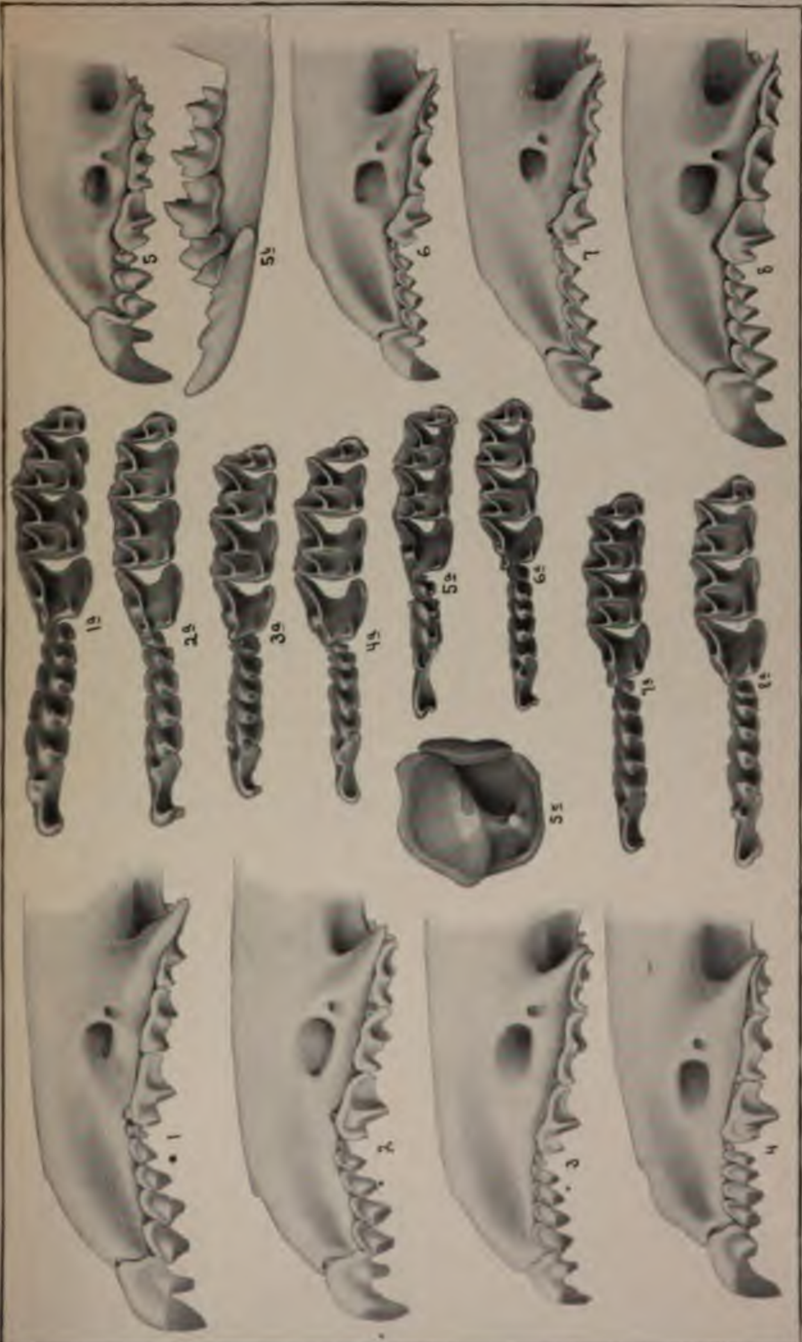
8. *Sorex dobsoni*. Alturas Lake, Idaho. Type.

(No. 31678, U. S. Nat. Mus.)

8. Upper jaw with teeth.

8*a* Crowns of upper series of teeth.

NOTE.—In this specimen the third unicuspid is abnormally



1. *Sorex richardsoni.* 2. *S. fumeus.* 3. *S. pribilofensis.* 4. *S. merriami.* 5. *S. hoyi.* 6. *S. longirostris.* 7. *S. personatus.* 8. *S. dobsoni.*

TE X.

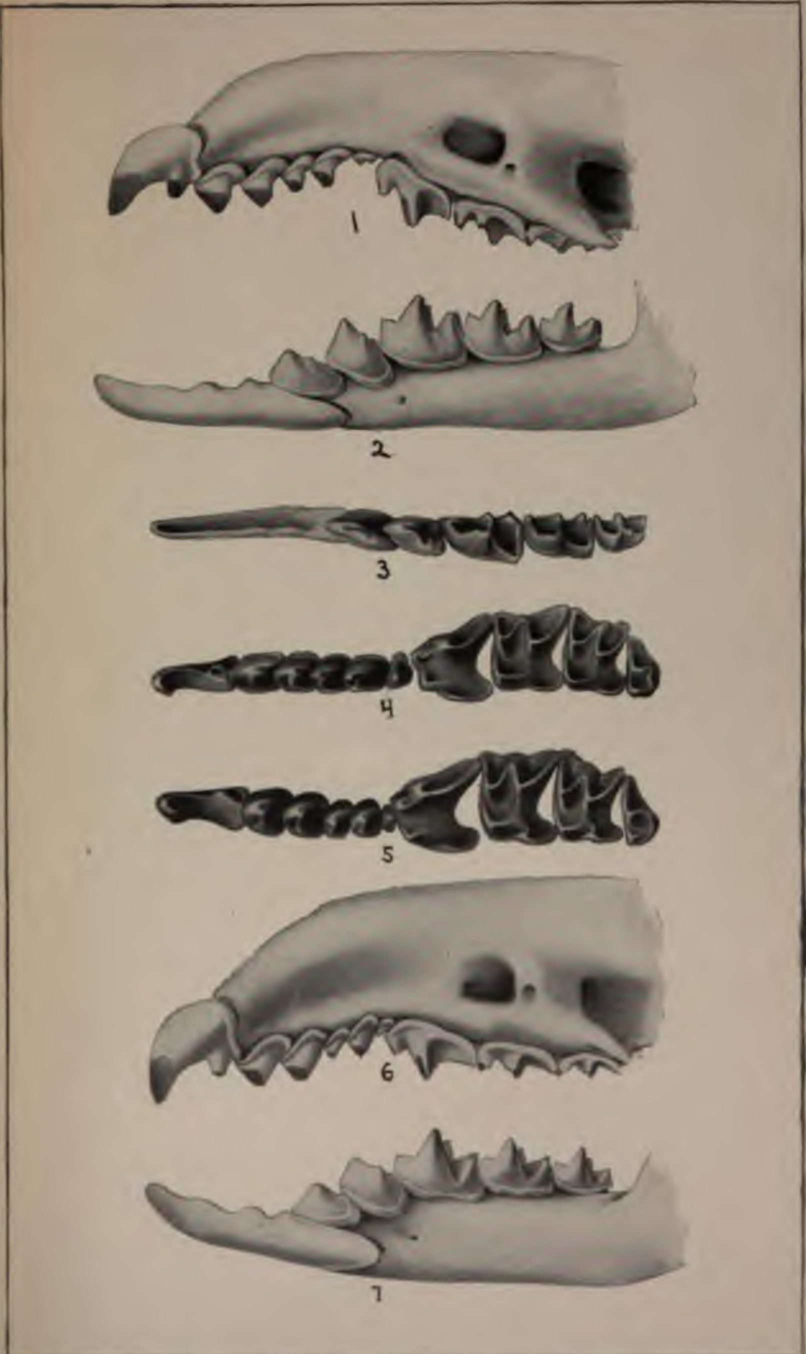
[Enlarged about seven times.]

FIGS. 1–4. *Sorex* (*Atophyrax*) *bendirii*. Easton, Wash.

1. Upper jaw (profile).
2. Lower jaw (profile).
3. Crowns of lower series of teeth.
4. Crowns of upper series of teeth.

5–7. *Sorex* (*Neosorex*) *palustris*. Elk River, Minn.

5. Crowns of upper series of teeth.
6. Upper jaw (profile).
7. Lower jaw (profile).



1-4. *Sorex (Atophyrax) bendirii.* Easton, Wash.
5-7. *Sorex (Neosorex) palustris.* Elk River, Minn.

TE XI.

[... ut seven times.]

Sorex (*Neosorex*) *navigator*. **Mount Whitney, California. Showing changes in** resulting from wear.

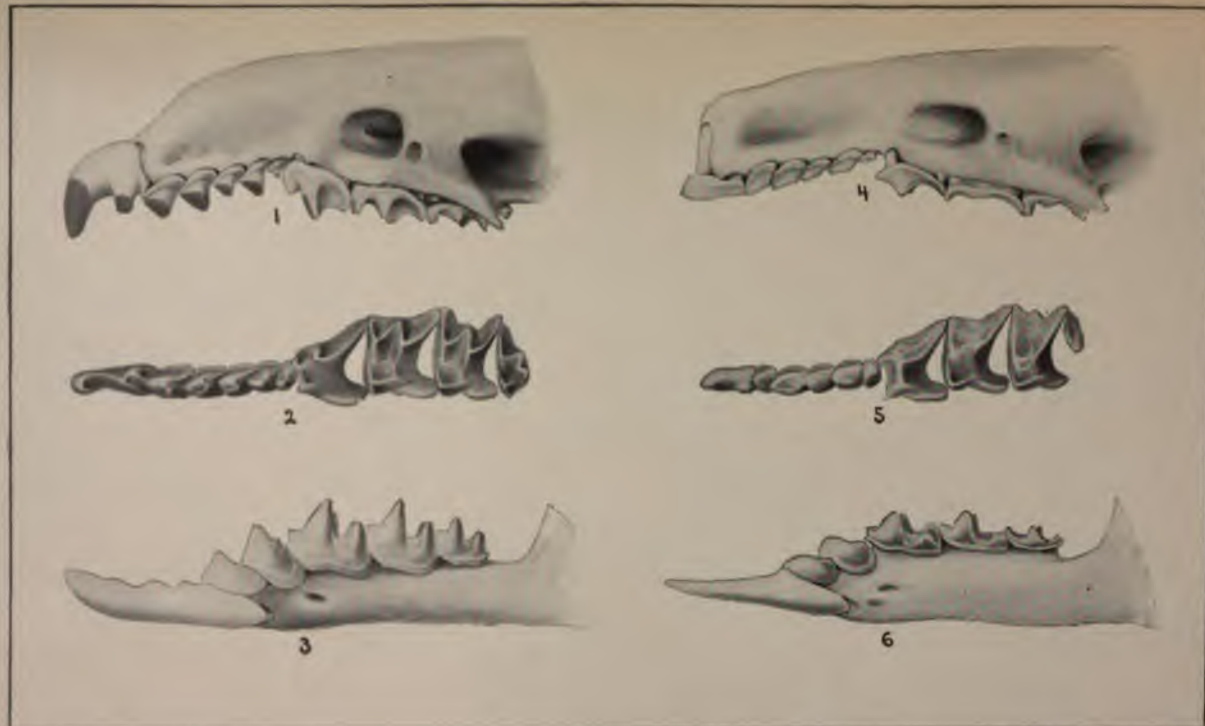
FIGS. 1–3. Young adult (No. 42412).

4–6. Very old (No. 42413).

1 and 4. Upper jaw (profile).

2 and 5. Crowns of upper series of teeth.

3 and 6. Lower jaw (profile)



Sorex palustris navigator, showing changes in teeth resulting from wear. Specimens from Mount Whitney, California.
1–3. Young adult. 4–6. Very old.

ATE XII.

ble natural size.)

FIGS. 1– *palmeri*. Oregon City, Oregon. Typ

(No. 56898, U. S. Nat. Mus.)

4– 5. *Sorex* (*Microsorex*) *hoyi*. Elk River, Minn.

(No. 2520, Merriam collection.)

6– 7. *Sorex californicus*. Walnut Creek, Contra Costa County, Calif.

(No. 44428, U. S. Nat. Mus.)

8– 9. *Sorex tenellus*. Lone Pine, Owens Valley, California. Type.

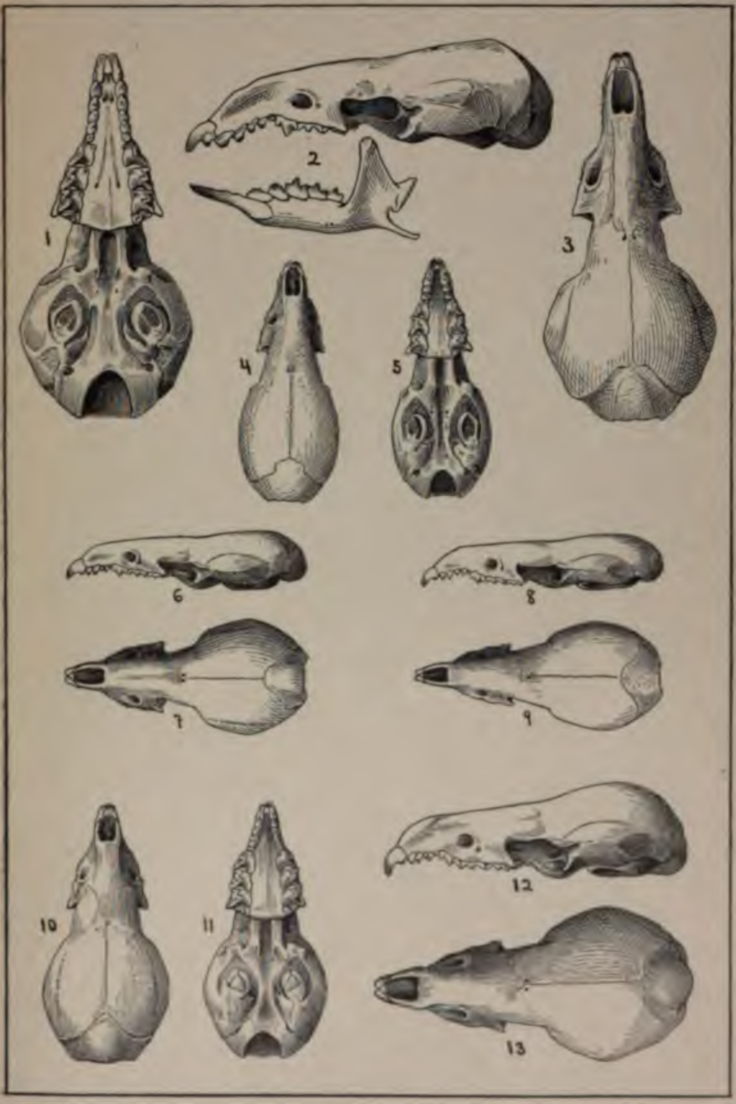
(No. 32495, U. S. Nat. Mus.)

10–11. *Sorex merriami*. Fort Custer, Mont. Type.

(No. 4861, ♀, Merriam collection.)

12–13. *Sorex macrodon*. Orizaba, Vera Cruz, Mexico. Type.

(No. 58272, ♂, U. S. Nat. Mus.)



1-3. *Sorex bendirii palmeri.*
4, 5. *S. hoyi.*
6, 7. *S. californicus.*
8, 9. *S. tenellus.*
10, 11. *S. merriami.*
12, 13. *S. macrodon.*